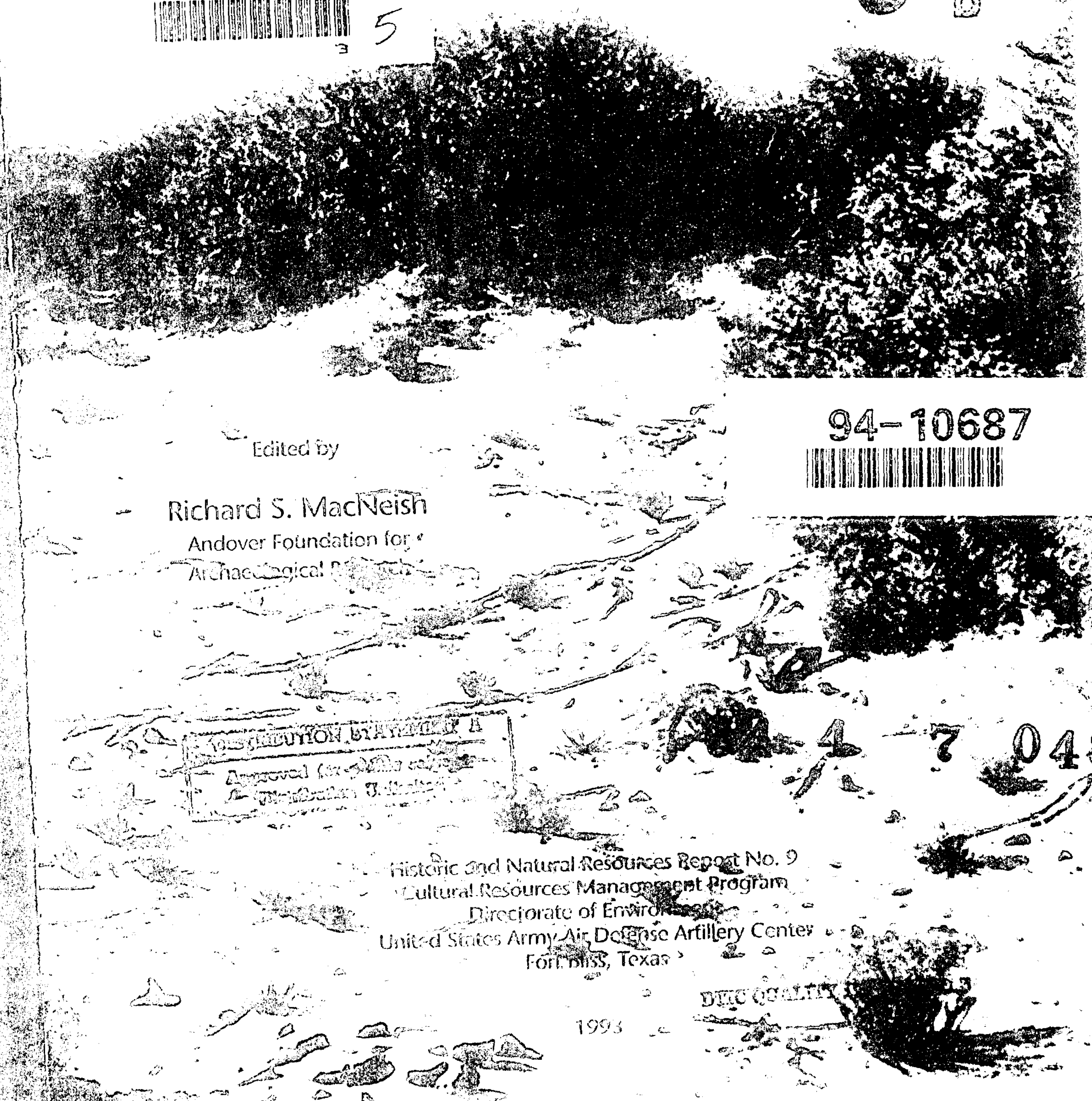
PRELIMINARY INVESTIGATIONS OF THE ARCHAIC IN THE REGION OF LAS CRUCES, NEW MEXICO



Edited by

Richard S. MacNeish
Andover Foundation for
Archaeological Research

Historic and Natural Resources Report No. 9
Cultural Resources Management Program
Directorate of Environment
United States Army Air Defense Artillery Center
Fort Bliss, Texas

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PREFACE

I gladly write this preface for whatever success the project has had is in no small way due to the many people who aided it and deserved to be thanked.

First and foremost in this realm is Steadman Upham. He not only convinced me that the Jornada region could yield significant data concerning the origin of agriculture in the Southwest, but he even gave me one of his "better" rockshelters, Tornillo, to initiate our excavations. More than tutoring me in Southwestern archaeology, introducing me to local scholars, lending me relevant books, and even letting me analyze his excavated materials, he was a real personal friend and made the project work by his practical assistance First and foremost, he had me appointed adjunct professor at New Mexico State University, with all the privileges that position implied: an office, telephone, storage facilities, use of copiers, and even use of the cafeteria for my crew. When he left the university, we stopped working in the Las Cruces area.

Of equal importance was my other top sponsor and archaeological colleague, Patrick Beckett, although my relationship to him was of an entirely different nature. I went to Stead to have a home-cooked meal, while Pat was my drinking buddy. Pat took me in as a friend from the moment we met and found we thought much the same. In addition to giving me his two best sites to dig–Todsen and North Mesa–he introduced me to all the right people and kept me abreast of everything happening in Southwest archaeology. From many standpoints he acted as my partner and certainly deserves credit and none of the blame for whatever good archaeology we did.

Of a similar nature was my relationship with David Hill. Besides educating me on Southwest archaeology and digging with my crew, he wrote a major section of this volume. Also of inestimable help with regard to site reports is David Carmichael, my most intense teacher during my first two years in Las Cruces. I owe him a great debt for my education in Jornada archaeology–and many of my best ideas grew out of discussions with him. Also helpful at every turn were local archaeological colleagues–Glen DeGarmo and Paul Lukowski at Fort Bliss; and Tom O'Laughlin, the late Rex Gerald, and Vern Scarborough, then all at UTEP; Brad Blake, Ed Stasky, and the late Fred Plog of NMSU; David Kirkpatrick, Melly Duran, Karl Laumbach, and all the group at Human Systems: and all those doing CRM–David Batchco, Barbara Kaufman, Chris Stevenson, Pete Eidenbach, and Bob Burton. All those others who helped us dig are mentioned and thanked more appropriately in the site reports of this volume rather than in the preface.

I also owe a vote of thanks to those who were helpful during the period of analysis and publication. Obviously Peggy Wilner, who ran my lab, is at the top of the list and is a coauthor of Chapter V of this volume. Of similar ilk was Jane Libby, the real editor for this volume, who was not only my constant companion, but our administrator and digger. Also helping with the publication were the various artists who did the illustrations for this volume: Jennie McBean, Barbara Dobbs, Mimi Horner, Bob Smith, Gail Bockley, and Lara Leech-Palm.

Needless to say, Glen DeGarmo of Fort Bliss, who ultimately was responsible for publishing this volume, also belongs to the above group. His environmental office at Fort Bliss provided continued help, in particular Donna Rand, who saw the manuscript through production. The cooperation received from Curtis Schaafsma, Tom Merlan, Don Reiley, and Ed Baca at the state office was just as good. In fact, the only people who deserve black marks are those in the Bureau of Land Management, both their inept archaeological staff locally, and the similar one nationally. They uphold the maxim that nothing is ever absolutely perfect.

Despite this one blemish, we received great cooperatic.ı, got to know a lot of nice people, and had a very enjoyable time during our excavations in the Southwest. We therefore owe a debt of thanks not only to the people mentioned above, but to many others in the region. Thank you, one and all.

Richard S. MacNeish

FOREWORD

Fort Bliss is pleased to publish this report as a courtesy to Dr. Richard S. MacNeish and as a contribution to the significant published literature about the archaeology of the West Texas and southern New Mexico region. This report is of importance to the cultural resources program on Fort Bliss and to any archaeologist working in, and interested in, the Fort Bliss and El Paso region.

Fort Bliss has contributed general editorial efforts toward production of this report. The report, however, was authored by Dr. MacNeish and his staff, and the reported data and their interpretations also are a result of their work.

GLEN DEGARMO, PH.D
Cultural Resources Management Program
Fort Bliss, Texas 79916

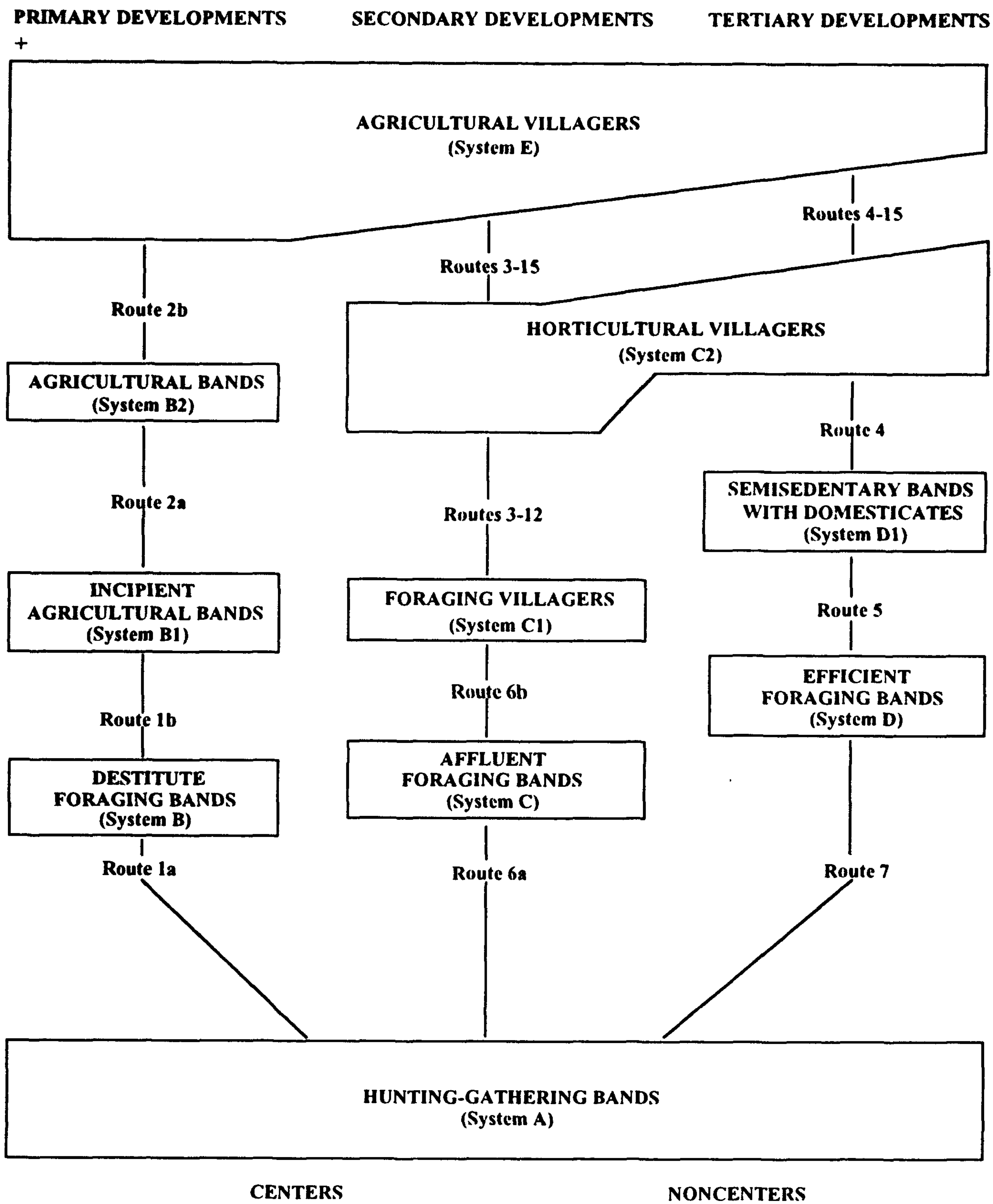


Figure I-1. Trilinear Development of Village Agriculture. The different routes to village agriculture.

Chapter I

INTRODUCTION

The research program of the Andover Foundation for Archaeological Research (AFAR) is part of the long-term (45-year) investigation of the problem of the origin of agriculture and settled life conducted by Dr. Richard S. MacNeish. Previous Foundation research in the Eastern United States, Mesoamerica, the Andean area, and the New World Tropics and comparison of these findings with those of various parts of the Old World have suggested a theory of Trilinear Development of Village Agriculture (MacNeish 1992). That theory recognizes three hypothetical developments (Primary, Secondary, and Tertiary) for three different sets of causes (see figures I-1, I-2, I-4, and I-5; also see Jones and Kautz 1981:123-37).

Some of AFAR's previous research projects tested these hypotheses with relevant archaeological data from the New World. At that time one key area–the North American Southwest–had few relevant archaeological data. When the opportunity came to investigate this crucial area, we jumped at the chance. In the summer of 1984, in conjunction with the program directed by Dr. Cynthia Irwin-Williams, we undertook an initial excavation in the Cuervo rockshelters located in the Rio Puerco region of central New Mexico (Irwin-Williams 1973).

The excavation of the rockshelters yielded 29 stratified zones going back to perhaps 2000 B.C. (San Jose phase). As the season came to a close, the author and two crew members, Laura Leach-Palm and Bob Swain, accepted the invitation of Dr. Steadman Upham of New Mexico State University (NMSU) to visit his cave sites that contained Archaic remains. These sites were located in the Organ Mountains near Las Cruces in southern New Mexico, an area in which little adequate research had been undertaken on the Archaic, the period during which agriculture originated. Upham's excavations, as well as those in Fresnal Cave near Alamogordo, New Mexico, and the La Cueva site east of Las Cruces, suggested very relevant materials did exist in the region (see Chapter II). Two reasons prompted this tentative conclusion. First, some poorly documented radiocarbon dates on Fresnal corn remains suggested they might be the earliest remains of corn in the Southwest. Second, this area was on a natural route, via Swallows' Cave near Casas Grandes in Chihuahua, to central Mexico where the basic New World agricultural plants (corn, beans, and squash) were domesticated. Although we had data on the primary development of village agriculture (see Figure I-2) in that early center of agriculture (Redman 1978:89-176), we still did not understand how agriculture came about in the Southwestern noncenter (Harlan 1971:468-73).

Upham invited the Foundation to join his field class, which was investigating the relevant Archaic period in stratified rockshelters in the southernmost part of the Organ Mountains east of Las Cruces. The joint investigation began in the spring of 1985.

We faced a twofold problem: We sought to define the Archaic period and to identify the development of village agriculture from the Archaic to the Ceramic periods. A reliable sequence needed to include crucial data about changing *subsistence systems* as well as other factors of the culture system that had caused the development of agriculture. To understand the Archaic, we needed a series of local sequences in each one of the relevant ecozones or microenvironments. Previous experience had taught us that one of the best places to find such local sequential data, which included preserved plant remains that would allow us to determine seasonality and subsistence systems, was in dry caves or rockshelters.

Our program, then, entailed digging stratified rockshelters using the best archaeological digging techniques (the La Perra method, MacNeish 1978:10-13; MacNeish and Garcia Cook 1975:69-73) as well as analyzing the data recovered so that the relevant information could be brought to bear on reconstructing the ancient culture sequence. From this reconstruction we hoped to acquire information that could be used to test our hypothesis on the development of agriculture.

Our research design thus involved the following plan:

1. Determine the ecological zones.
2. Obtain archaeological sequences in each of these ecological areas.

3. Reconstruct the way of life during each phase of these sequences.
4. Analyze the sequences to determine the causes of change within each.
5. Compare or test these data against our relevant hypothesis so as to confirm, deny, or modify our hypothesis.
6. Compare or test these trial data with similar data from other culture areas to confirm, deny, or modify our general hypothesis.

Although our objectives are far from completed, we do think we have collected data that are relevant to the solution of our wider problems. The following chapters describe what AFAR has uncovered through its field work.

Chapter II describes three major excavations–Tornillo, Todsen Cave, and North Mesa–identifying their location and ecology, the excavation and recording techniques used, the personnel involved, and the stratigraphy of each site. Also included is information on the excavation of various Organ Mountain Sites, La Cueva, and Fresnal Cave; and on the survey of Archaic sites in the Tularosa Basin of south-central New Mexico.

Chapter III concerns the interdisciplinary methodology and analyses involved in our program, which include the following: the identification of environmental zones and their seasonality, reports on maize (corn) data, a description of the botany and zoology of the region, studies of use-wear patterns and of blood residue on artifacts, and reconstruction of diet by analysis of the carbon 13/12 and nitrogen 15/14 isotopic ratios and as found in the bones of skeletons recovered from the area.

To this basic background and excavation data, Chapter IV adds a detailed discussion of chronology, both relative and absolute. The relative chronology is derived from the typology of projectile points, bifaces, laterally and terminally worked unifaces, ground and pecked stone, bone and shell artifacts, perishable artifacts, and ceramic seriation. Absolute or chronometric chronology covers dates derived from obsidian hydration, radiocarbon determinations, and crossdating our radiocarbon determinations with Archaic dates derived from related surrounding areas–the kind of descriptive data that are needed badly in the Southwest so that generalizations can be made about culture change.

In Chapter V we attempt to reconstruct the way of life of each occupation in each of the stratigraphic zones of the different sites we dug, with an eye to reconstructing the culture of sequential phases.

Finally, Chapter VI contains an analysis of our sequential data used to determine why the subsistence system changed and led to village agriculture by the El Paso phase (A.D. 1100-1300). These data then are compared with the fine data on the Oshara Tradition of the Colorado Plateau as well as the less-adequate Archaic data from the Mogollon Rim and Gila Drainage. These comparisons lead us to conclude the data effectively test our hypothesis of the Secondary and Tertiary developments of village agriculture.

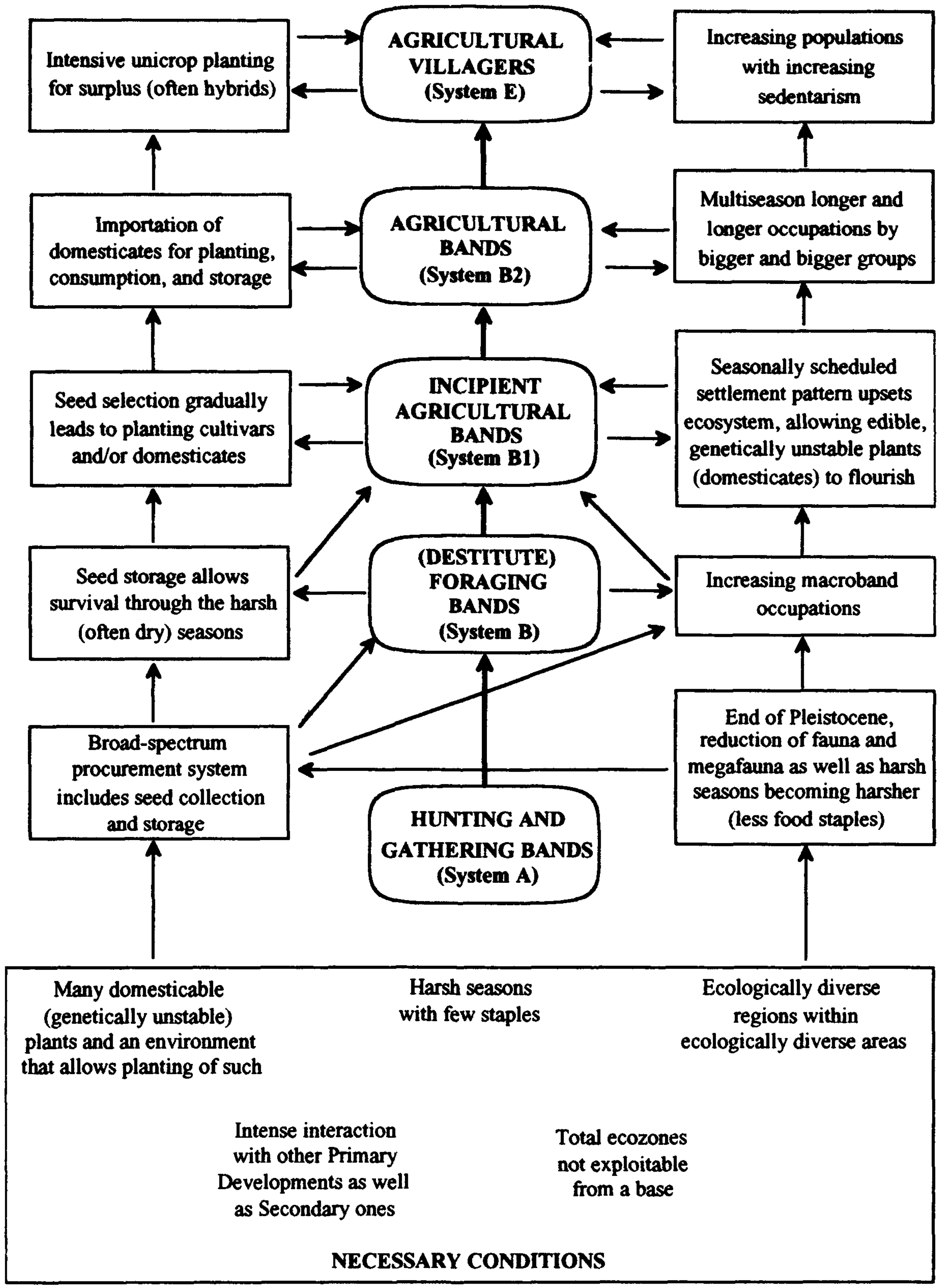


Figure I-2. Necessary and Sufficient Conditions as a Positive Feedback Process in Primary Developments

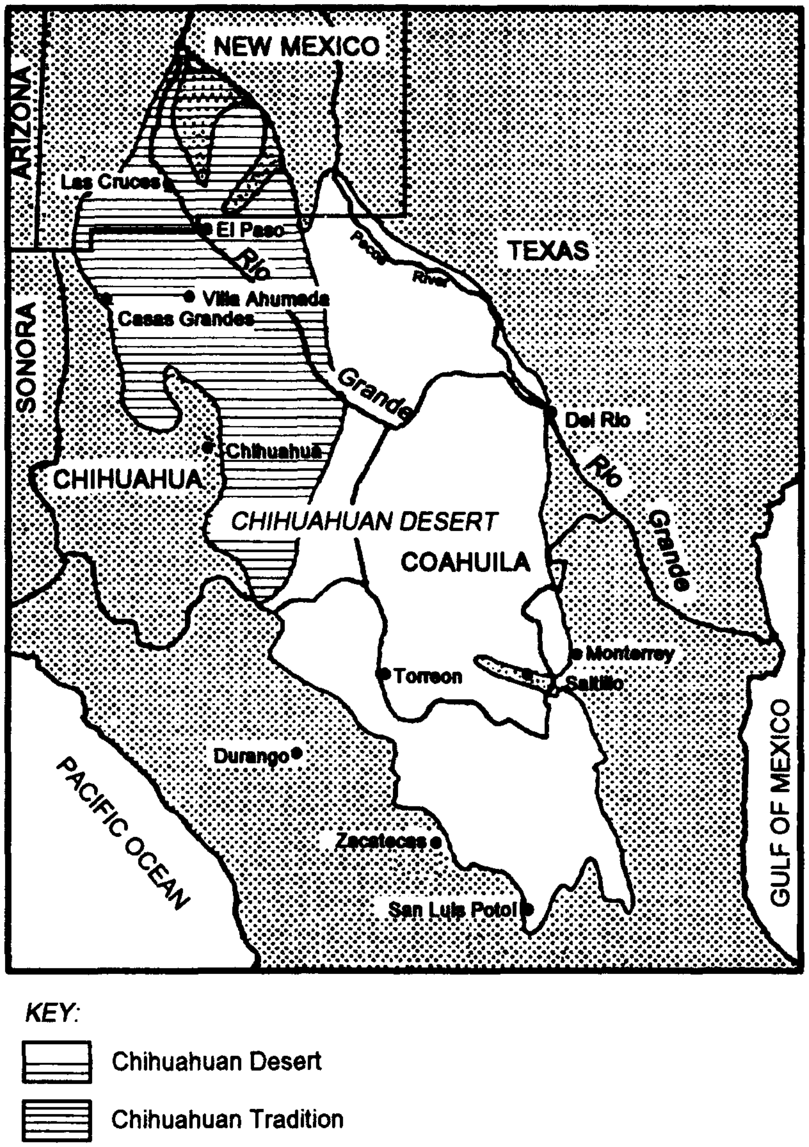


Figure I-3. Area of the Archaic Chihuahua Tradition

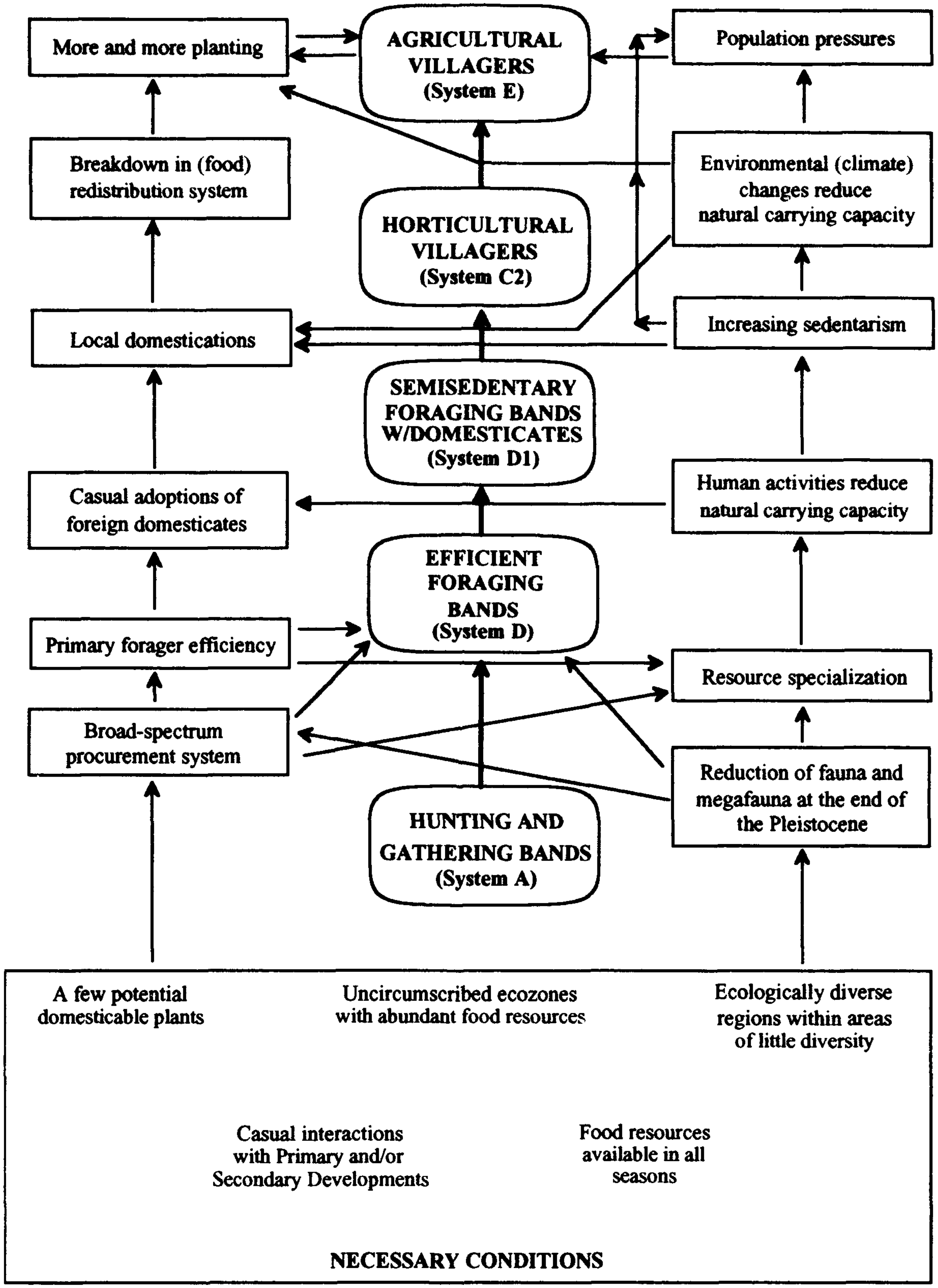


Figure I-4. Necessary and Sufficient Conditions as a Positive Feedback Process in Tertiary Developments

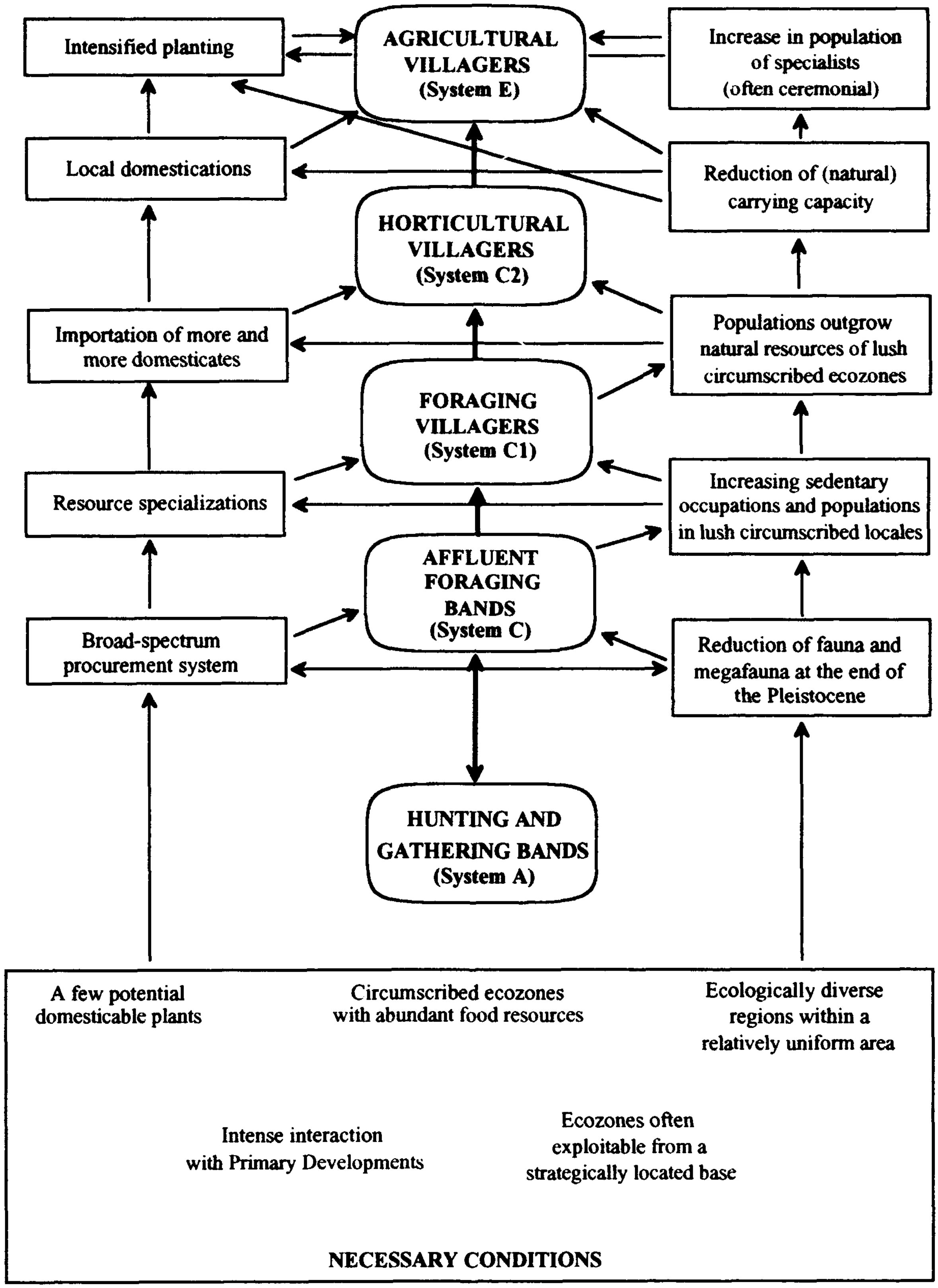


Figure I-5. Necessary and Sufficient Conditions as a Positive Feedback Process in Secondary Developments

Chapter II

THE EXCAVATIONS

Since 1985 AFAR has dug three sites in the Las Cruces region of New Mexico–Todsen Rockshelter, Tornillo Rockshelter, and North Mesa. This chapter will describe the excavations and briefly will mention relevant excavations undertaken by others–La Cueva, Fresnal, and the Organ Mountain sites. The following pages locate the excavations, identify the personnel involved, describe the field techniques used, and discuss the stratigraphy uncovered. The data acquired from these excavations establish the foundation for later discussions of chronology and the culture contexts of the various occupations in an attempt to reconstruct the ancient way of life.

Todsen Rockshelter–LA5531

Todsen Rockshelter, sometimes referred to as Todsen Cave, is located on the south side of Spring Canyon, on the north fork of Box Canyon, at longitude 106°55'03" and latitude 32°20'31" in the northwest quarter of section 2, Township 23, south R1 west of the New Mexico principal meridian in Doña Ana County, New Mexico. Its floor is elevated about 4,432.5 feet above sea level. In the survey records of the Laboratory of Anthropology in Santa Fe, New Mexico, Todsen is designated LA5531 (see Figure II-1).

The rockshelter under the overhang is about 18 m east to west, but only about 4 m north to south. The floor slopes upward more steeply in the last 6 m on the west side and drops off into the talus slope about 5-6 m north of the rear cave wall, so the shelter has a relatively flat floor only in an area roughly 12 by 6 m. The talus slope drops about 11 m (35 feet) to the arroyo bed, which is about 31 m (100 feet) north of the back wall of the cave. In front of the cave the canyon itself is only about 200 feet wide and has a maximum depth of just more than 46 m (150 feet). The cave faces north and is protected poorly from wintry blasts by the north wall of the canyon.

The canyon itself winds northwestward for about 2 miles, becoming narrower and shallower; to the southeast it connects with Box Canyon, about 4 miles from the cave. Of key importance are two springs or seeps, one about 200 feet north-northwest of the cave and the second, larger one about 300 feet northeast of the cave. Furthermore, the Rio Grande itself is only about 6 miles down canyon to the east of the rockshelter.

Environmental Niches

Within the region where primitive people might have collected food in a day's foray are several ecozones or environmental niches. Todsen Cave is almost within the catchment basin area of the lush Rio Grande environmental niche. More critical to the occupation of the cave, however, are the two nearby springs, which are major sources of water for game. In fact, they provide the only sources of water in the dry season months, from February to May. Mule deer *(Odocoileus hemionus)*, antelope (*Antilocarpa americana)*, rabbits (*Sylvilagus audoboni* and *Lepus californicus)*, cougar *(Felis concolor)*, and other animals, as well as cattle, still use the spring's waters regularly in the dry season. Further, during the wet season, from June to October, the springs and runoff water from rains (8 inches per year) give the canyon a slightly more lush environment, almost a gallery or arroyo forest comprised of more and larger mesquite *(Prosopis juliflora)*, tornillo *(Prosopis pubescens)*, desert willow *(Chilopsis linearis)*, and acacia *(Acacia spp.)*, as well as grasses, prickly pear *(Opuntia spp.)*, and fourwing saltbush *(Atriplex canescens)*, all of which are sources of food in the late spring and summer (April through September). These plants also attract game, both large and small, and in the wet season snakes, lizards, turtles (family *Emydidae*), toads, and frogs, as well as a wide variety of insects and fowl are present. Among those animals that do not hibernate or migrate, some winter in the canyon, which rarely has frosts (less than 20 days a year) or snow. Any snow that does fall, quickly melts.

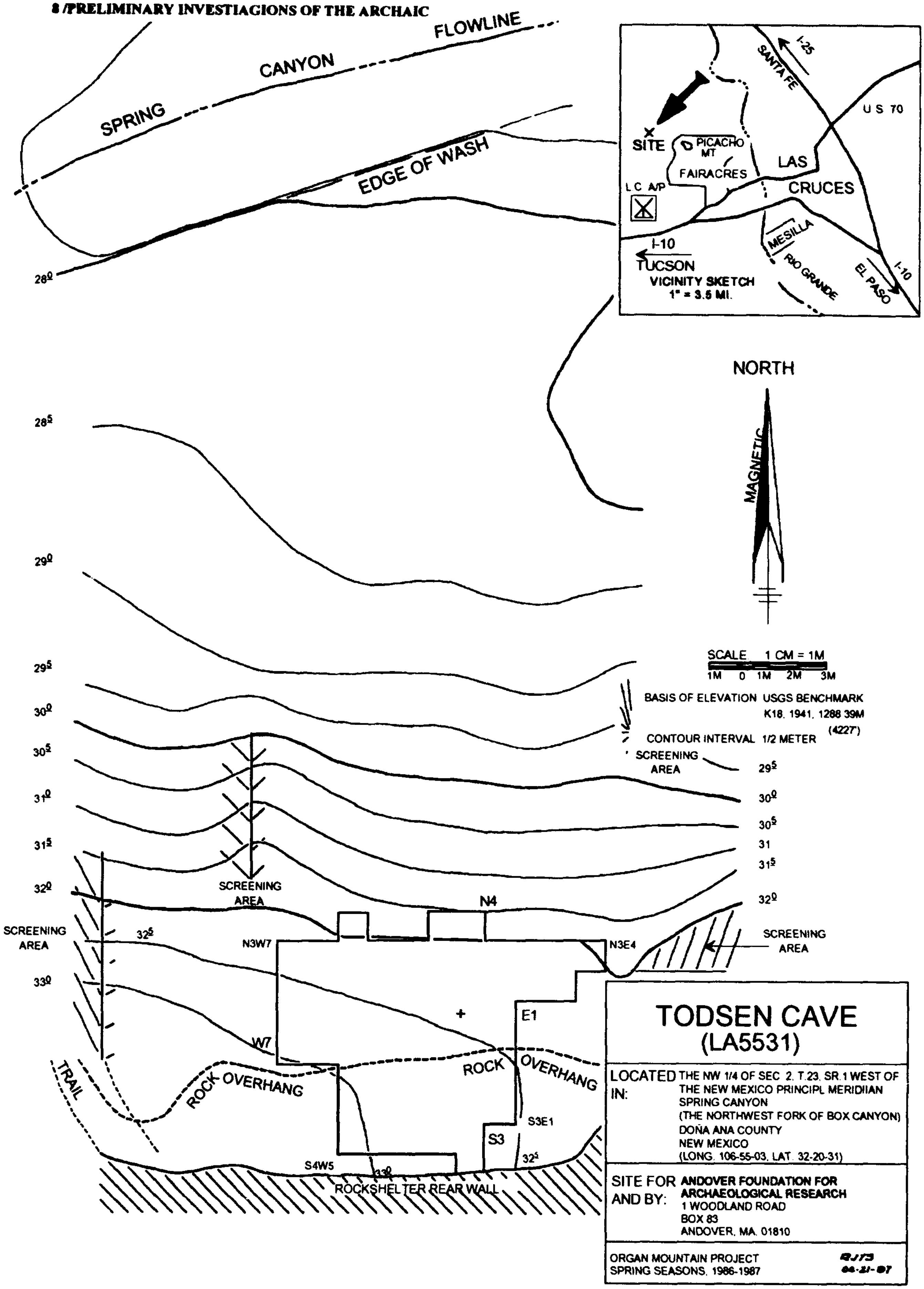


Figure II-1. Contour Map of Todsen Cave (LA5531)

The rolling slopes above the canyon are in the upper Bajada ecozone and are much less attractive, except in the rainy season. In this area the trees (now relatively rare) are small-leaf sumac *(Rhus microphylla)* and mesquite, but they are outnumbered by opuntia, yucca, whitethorn acacia *(Acacia constricta)*, sotol *(Dasylirion wheeleri)*, saltbush, and grasses. The dominant animals in this zone are jackrabbit and pronghorn antelope, with deer, birds, small mammals, and reptiles (mainly rattlesnakes) present in the wet season.

We have not completed our study of the pollen to see if the vegetation has changed since the Pleistocene, when the region was wetter and cooler. Local studies, however, suggest it has not changed much (Horowitz et al. 1981).

Most of the soils on the mesa top above the canyon are Late Pleistocene (lake) gravels. The canyon itself, the arroyos, and the nearby hills, including Picacho Peak, have rhyolite and welded tuffs (usable for chipping artifacts), tuff breccias, and volcanic felsitic flows of the Oligocene (Gile et al. 1981).

Although it is not a luxuriant environment, the shelter, with its nearby springs, comprises the most inviting part of a not very inviting zone, particularly in the late part of the dry season (late winter-early spring), when the surrounding area has few readily available foodstuffs.

Digging Technique

The initial surface finds, particularly on the talus slope–from a fragment of a Folsom point to sherds and much (beer) bottle glass–indicated Todsen Rockshelter had a long occupation. These finds encouraged Pat Beckett, Tom O'Laughlin, and Brad Blake to put a 6-m-long test trench in the rockshelter in the cold December of 1968.

The trench was dug from north to south in arbitrary 6-inch levels to what they thought was the floor at a depth of about 25 to 30 inches, except in the northernmost square where they dug to a meter and encountered no rock layer. They also drew two 6-m-long profiles and identified at least six strata, which we were later to call zones A, B, C, D, E, and F. In all of these strata they found sherds, although very few appeared in E and F, as well as four projectile points, one of which (Beckett's type 10) they thought might be Archaic.

In 1985, at the end of the season in which we dug Tornillo Cave (see next section), Tom Todsen, who did not know LA5531 had been excavated, took me to this cave. We made a large surface collection and found several (11) Archaic points. Next, Dr. David Carmichael and I visited the cave and tested it with a soil auger. At roughly N1.3W0.85 we found the refuse was at least 2 m deep. As the final aspect of that season, Beckett gave me a 20-page copy of his report (Beckett and O'Laughlin 1968). After considerable discussion, Beckett, Carmichael, and I decided the rockshelter probably had an Archaic occupation, most likely in the deeper deposits the test trench had not reached. AFAR decided to concentrate its 1986 season redigging the shelter, before it was totally looted.

The first task was to find Beckett and O'Laughlin's old trench and then give its squares designations and grid coordinates. A couple of shovel traverses (6 inches deep) across the mouth of the cave found the edges of the trench. We staked it out and designated the east edge as the north-south 0 grid line of stakes S4, S3, S2, S1, 0-0, and N1. We identified each square by the stake in its southeast corner.

The next task was to re-excavate the 1968 trench, clean off the two vertical profiles, and give the strata zone names. We identified zones A, B, C, D, D1, D2, E, F, G, H, I, and X on the east wall, with G, H, and I constituting a pit area. Next we gridded the whole area in 1-m squares with iron rebar stakes painted with black and white 10-cm stripes and set up a datum stake on the back wall of the cave at 4,435 feet above sea level. We also took a series of photographs of the cave and established our forms for keeping records: diary sheets, square description sheets, feature and burial sheets, obsidian and C14 chronology sheets, topographic sheets for datum depth, photographic sheets, and so on (see MacNeish et al. 1981: 6-15 for examples of forms). We used small ziploc bags for specific kinds of artifacts and ecofacts within each square, and obtained 1-liter plastic bags to hold samples of soil, pollen, and flotation for each level of each square. Needless to say, we also gathered together toolkits and other tools, the latter lent by Upham for digging in Tornillo Cave. Tom Todsen provided photographic equipment, and Paul Johnston was supposed to do the mapping and obtain the surveying equipment, neither of which happened. Ric Frost, our administrator, rented a Dodge van from Ed Sandoval to carry us to the end of the road for our mile walk into the site. By the first week in February, 1986, we were ready to begin excavation.

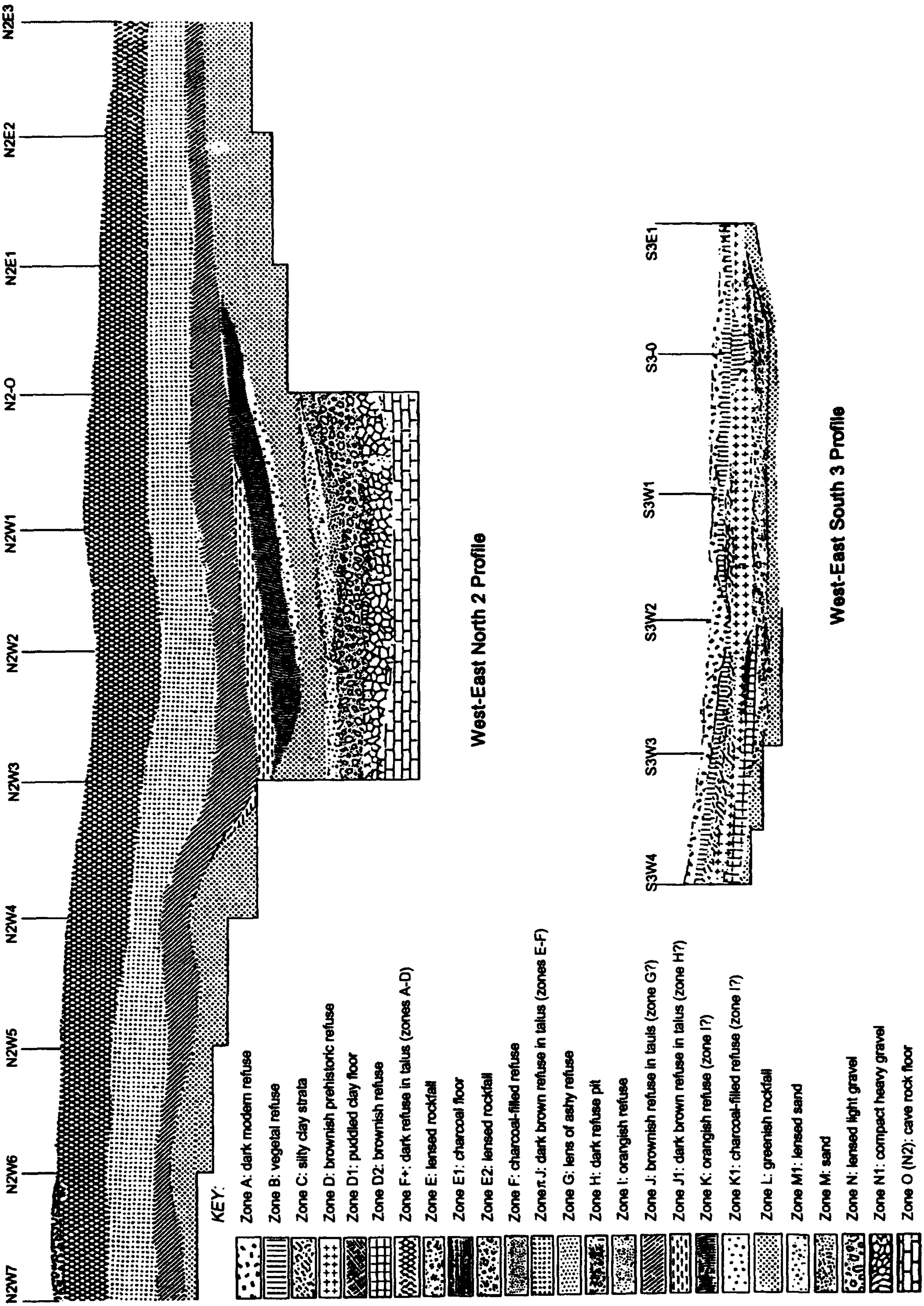


Figure II-2. **Stratigraphic Profiles of Todsen Rockshelter**

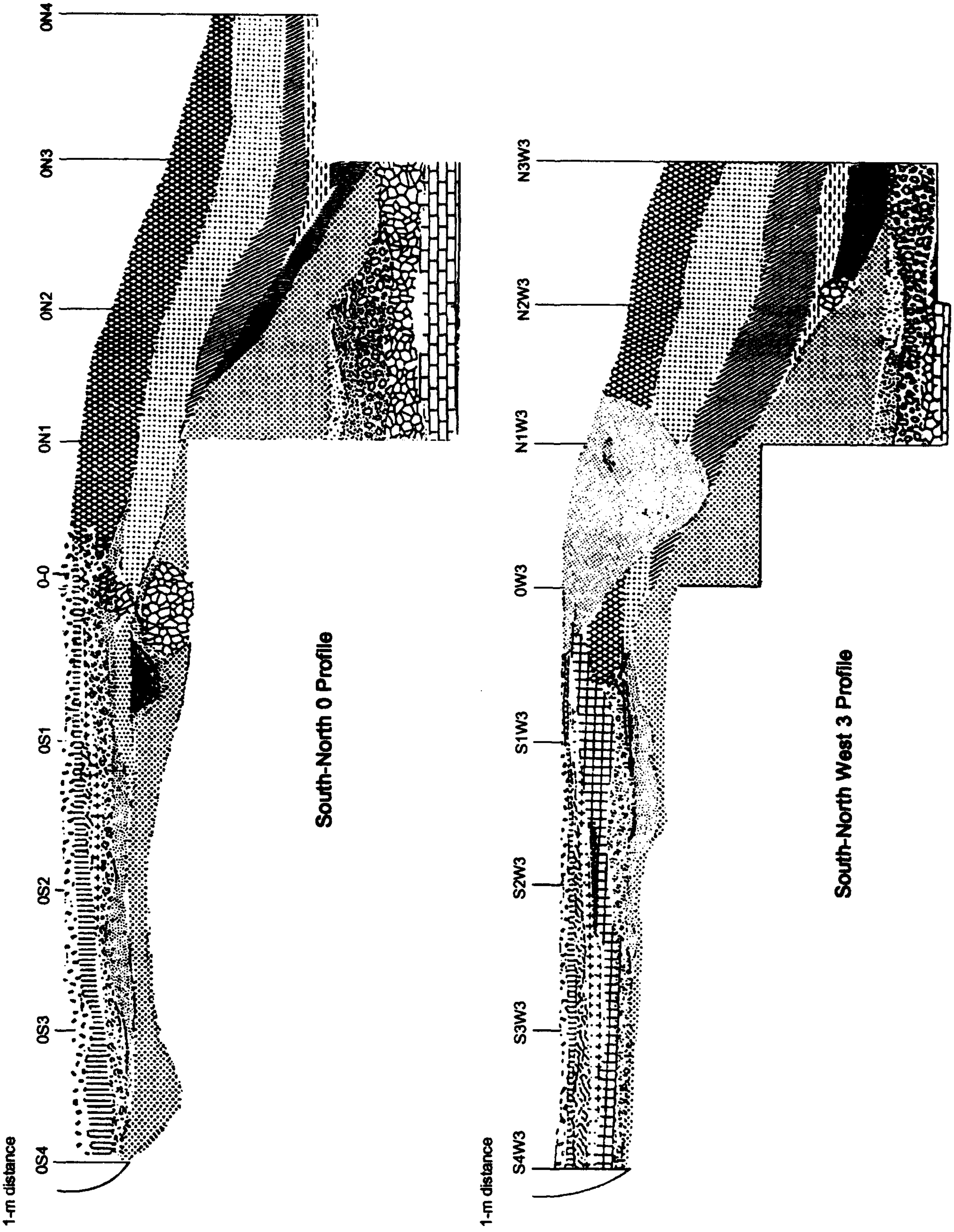


Figure II-2. continued

The excavation was under the overall direction of myself. Our crew chief was Daniel Finamore, then a graduate student at Boston University. His steady crew included Sally Anderson and Carroll Conquest, students at Boston University; Laura Johnson, a student at Cornell University; Richard Lesure, a student at Princeton University, and Jane Libby, our editor. Often assisting them were Tom Todsen, Phil and Sharon Secor, and Mary Russell of El Paso; Linda Rose, Paul Johnston, Ric Frost, Viviane Renard, and Laura Greffeniuis of NMSU; and Urna Linnamae, head of the Department of Archaeology and Anthropology at the University of Saskatchewan, Canada. Various Friends of the Foundation (Friends)–Don Corbett; Barbara Dobbs; Fuzzy Downs; Betty Hageman; Adam, Steve, and Samantha Halem; Lady Harrington; Teresa Mariaca; Jennie MacBean; and Shimon Mednick–each assisted us for a couple of weeks. Visitors helping for shorter periods included Jackie Blake, Rod Barton, Paul Callson, Richard Cooper, Pat Crawford, Sally Crowder, David and Mary Finamore, Mary George, Rex Gerald, David Martinez, R.W. McNeill, Nicole Rousmonière, John Shea, Chris Stevenson, and Upham. Generally speaking, we fielded a crew of about eight, which gave us four two-person crews, one digging and taking notes while the other carried buckets, screened, and catalogued finds. Peggy Wilner took responsibility for the cataloguing and laboratory analysis of our finds.

In terms of actual excavation we used the La Perra technique and stripped off strata from a vertical profile in alternate squares. We started working east in S3E1 and S1E1 and west in S4W1 and S2W1. Next we excavated S2E1, 0E1, S3W1, and S1W1 to obtain a 3-m-wide trench. Following down the deep floor we dug 0N1 and 0N2 as well as N1W1 and N2W1. Near the end of the season, these squares were carried down to the floor of the cave, some 2.5 m below the surface. We also extended a 2-m-wide trench westward to W6, between the N1 and N3 profile. By the close of the 1986 season we had a large L-shaped trench, most of which was 1 m deep, with one portion at the junction of the arms more than 2 m deep.

During the excavation we recovered an extensive sample of lithic artifacts (600+), sherds (2,000), ecofacts (10,000) including bones, many chips, and a few vegetal remains; we also took many samples for soil, flotation, and pollen analysis. The six partial skeletons we uncovered provided material for C13/12 analysis (see Chapter III, Section 4). What really was important was that all the artifacts and ecofacts came out of 21 well-defined stratigraphic zones as well as from specific squares or exact *in situ* locations. Our sample was, however, very skewed: zones C and D2 had only a few sherds, while zones D and D1 had many; zones J and J1 had many lithic artifacts, while zones E, G, H, I, K, and K1 had few. We could classify some of the artifacts into cultural phases, but our sample from the earlier zones made such classification extremely tentative. While we had made a great start in 1986, much remained to be done.

In 1987 AFAR began its second season at Todsen, from January 20th to May 10th, again directed by myself. Our crew was mainly new and under the very capable direction of Sally Anderson, who had been a student worker the previous season. Under her were Jane Libby and Tom Todsen, veterans of the previous season; John Fox and Jon Vanden Bosch of Boston University; Peter Dawson of the University of Toronto; Ann Henshaw of the University of Maine; Kelly McClarey of Washington State University; Bunny Bennett of the University of Houston; and Bob Smith and Dave Hill, both freelance archaeologists. Peggy Wilner again directed the cataloguing process and laboratory analysis. This basic crew of eight or nine was supplemented by many visitors and Friends of the Foundation–Zoe Anderson, Jim Bennett, Wes Bliss, Lois Brennan, Don Chrisman, Richard Cooper, Betty Hageman, Laurie Heckman, Dave and Mimi Horner, Maryane Lewis, Jennie MacBean, Bruno Marino, Tom Moody, Peggy Rose, Phil and Sharon Secor, Meeks Etchieson, Steve Ireland, and various occasional visitors.

Our strategy for the 1987 season was to recover more of the earlier materials; we therefore concentrated our efforts on the squares down the talus slope where deposits were deeper. The trench between the N1 and N3 axes was extended east and west to E4 and W7 and deepened, using the same La Perra technique as the previous season. The west arm was pushed southward to E2 and finally the shallow southwest squares, to S4W5, were excavated. Many more artifacts were uncovered as were two more burials. As the typology section shows (see Chapter IV), the lower levels yielded enough artifacts so that we could define all four of the Archaic phases–Gardner Springs, Keystone, Fresnal, and Hueco. Occupations during the Ceramic phases–Mesilla, El Paso, and Apache–could be recognized in the upper levels.

Stratigraphy

We have obtained some dates, both obsidian and radiocarbon determinations, for some of the phases at Todsen and can estimate dates for most of the stratigraphic zones (see Chapter IV). The best aspect of this excavation is that we have clear-cut stratigraphy, which is discussed in the following paragraphs, going from bottom to top (see Figure II-2).

Above the rock floor of the cave, which is an Oligocene conglomerate, are at least two main gravel zones designated zones N and N1 (and sometimes N2). However, according to Dr. Rich Earl of the Department of Geology of NMSU, they both may be the same depositional unit laid down in the Late Pleistocene. Zone N2 was very compact and had many large boulders in it; it was noticeably different from zone N1, which had some pebbles and was less compact because it contained much sand. Grain analysis of the sand (and gravel) suggests they were deposited in the bed of a stream when permanent water flowed through Spring Canyon at about 10 m above the present arroyo bed. These depositions thus represent the highest terrace in Spring Canyon, through which later erosion has cut. A rough traverse down the canyon suggested to Earl that the gravels connect with the high Pleistocene terrace of the Rio Grande, which contains the bones of mammoth, mastodon, and other extinct animals and dates roughly between 10,000 and 20,000 years ago. We chopped through this deposit, from 30 to 40 cm deep, in at least eight squares–N2, N2W1, N2W2, N1, N1W1, N1W2, 0W1, and S1W1. We did this for one reason, because we kept finding slivers of bone (often fossilized), occasional flakes, and a number of pebbles with flake scars, mainly in zone N; these suggested there might be an associated human occupation. However, we never did find a well-defined floor nor were the so-called artifacts in reliable contexts.

Overlying the gravels of the high terrace in the front of the excavation were sands. The top lensed sands we (mistakenly) designated zone M1, while the lower sands without discernible bedding were called zone M. Zone M, about 5-30 cm thick, capped zone N everywhere, but zone M1 occurred mainly in squares N2, N2N1, N1, and N1W1 and never was more than 30 cm thick. Earl interpreted these zones as possible sandbars in what then was the arroyo bottom, when there was an intermittent or seasonal stream in Spring Canyon. Although the zone had hints of occupation, none of these hints were in a reliable cultural context. Both the gravels and sands were brown in color and in terms of the Munsell system ranged from hue 5YR 5/6 to hue 10YR 8/8. In terms of datum depths, these four (noncultural) zones were between 2.4 and 3.2 m below datum. Also, zones N, N1, and M probably underlay the whole rockshelter and were under zone L, a brown (Munsell 2.5Y 6/6) to greenish yellow (7.5Y 7/8) of compact underset rock.

In Beckett's initial trench and in our extension of it within the cave during the 1986 season, zone L was thought of as the floor of the cave, and it certainly looked just like the same type of rock as the roof of the cave. Also, north of the dripline it sloped downward, just like a cave floor. Then, in late April of that year, in the northernmost corner of our trench–square N2W1–one of our students broke through the "floor" and found sands of a rodent burrow in zone M, with artifacts, and under these gravels, zone M1, with possible pebble tools. We therefore started the 1987 season with visions of pre-zone L, early Paleo-Indian remains, dancing in our heads. After we extended the west trench and chopped through zone L, we determined it was a huge rock fall that occurred after the Pleistocene and was some 2 m thick in the south (back) of the cave, pinching out between the N2 and N3 east-west grid lines. Further, we found no reliable evidence of "Early Early Man or Woman" under it, just tantalizing hints that kept us chopping through it in the early part of the 1987 season. The thin north edge of this rock fall, zone L, was riddled with rodent burrows that did contain intrusive artifacts and ecofacts that lured us on in this futile effort. Further, there really were ecofacts and artifacts just in front, to the north of zone L, in zone K or K1, as well as on top of it, so it was worth digging down to if not through.

The earliest of the actual zones that did have artifacts in reliable contexts was zone K1. Never more than 14 cm thick, it was located mainly in three squares (N2W2, N2W1, and N2). In the north half of these squares, in front of the pinched out part of zone L, it was relatively level. In the south half of these squares, as well as the north half of N1W2, N0W1, and N1, zone K or K1 was on top of the greenish rock of zone L and sloped slightly upward (30°) on the end of this rock fall. One area, about 20 cm in diameter, at N2.81W1.65 had burned rock and charcoal that could represent a hearth. The whole zone (K1) in fact was filled with charcoal and burned rock and had a few bones, chips, and pieces of cores as well as about 82 artifacts, which are the basis for our preliminary definition of the Gardner

Springs complex. In the Munsell color system, zone K1 varied from 10YR/1 to 2.5Y 3/2 to 5Y 4/4. We believe this zone represented an initial occupation of the cave for a very brief time by a small group. Perhaps it occurred before the roof of the cave fell and covered the area. It also has been suggested that zone K1 represents the refuse of people who lived in the cave, perhaps on zone I, and threw their refuse down the slope to form zone K1 at the foot of the rock floor of zone L. The possible hearth and the fact that all three of the boulder anvil milling stones were lying relatively flat argue against the hypothesis that zone K1 was dumped refuse and for the hypothesis that it was the floor of a brief small occupation. It was not a large area of deep refuse and had too few artifacts; even more unfortunate, the charcoal recovered failed to yield a valid C14 date.

Over the entirety of zone L was a thicker and more extensive orangish brown layer of refuse, called zone K1. In fact, K1 initially was thought to be a floor in the bottom of zone K. In the Munsell color system, zone K had hues of 10YR 8/8, 7.5YR 7/8, 5YR 7/8 to 2.5YR 7/10. Acidity tests suggest it had been fired heavily. It often was relatively thick, with a maximum thickness of 42 cm, but pinched out rapidly at its eastern edge (at N3E1) and at its western edge (at N3W4). The zone was relatively horizontal east and west, but since it lay on or in front (north) of zone L, zone K sloped down from south (high) to north (low). Probably more of this zone exists down the talus north of our area of excavation, but we had trouble seeing the zone on our north (N4) profile, so we did not dig this portion. It is difficult to determine whether zone K represents refuse dumped down from some occupation in zone I, which was similar in color to this zone, or whether it was a series of occupations in front of the cave. Zone K included a possible burned rock hearth with a pronghorn antelope bone that gave a date of 3669 B.C., and some of the milling stones were lying horizontal, while others were not; most of the chips, including an obsidian chip dated 3434 B.C., were not horizontal. In fact, although the evidence is far from convincing, I would estimate that this was both a dumping area and an occupied zone.

Regardless of how zone K was deposited, it contained a good sample of artifacts (104) and ecofacts (more than 2,000), which helps define the Keystone complex. The dated material suggests the deposit was laid down in the latter half of the third millennium before Christ. Although some bones come from other seasons of the year, the majority seem to be from the dry season–late winter to early spring–which seems to agree with the discovery of many grinding stones that could have been used to mull grass seeds that reach fruition in the spring of the year.

Above these earliest occupational strata, mainly in the talus, the character of our talus stratigraphy changed noticeably–the refuse was stickier, more claylike, less granular, more acidic; contained less charcoal, and had a tendency to be darker brown in color. These zones–J1, J, πJ, and F+–were much more difficult to distinguish in the talus and had some rodent burrows in them.

The first of these, usually overlying zone K, was called zone J1. Dark brown in color, it was fairly easy to distinguish from zone K, but often difficult to distinguish from the overlying zone J. In the Munsell color system, zone J1 ranged from hues 10R 3/2 to 2.5YR 3/4 to 5YR 3/2 to 10YR 4/4. It was relatively plastic but dried into hard, angular lumps. Zone J1 usually lay directly over zone K, except in squares N1W2 and N1W3, where it overlay the greenish brown rock of zone L. In area, zone J1 covered about the same extent as zone K, but was usually a little thinner, with a maximum thickness of about 32 cm; it usually sloped down at about a 30°-45° angle, roughly parallel to the underlying zone L. Zone J1 had few features in it, and the majority of its artifacts were not lying horizontal. The suggestion that it is refuse dumped down the talus slope by cave inhabitants (perhaps using zone H), is a viable hypothesis. Radiocarbon and obsidian hydration dates suggest a deposition somewhere in the middle of the second millennium before Christ. Also the artifacts (84), somewhat less numerous than those of zone K, are radically different in type, suggesting the deposition was made by a new culture, called Fresnal.

Further, remains from the Tornillo and Fresnal sites suggest some domesticated plants were being utilized at this time. The change in the character of the stratigraphy thus correlates well with a shift in cultural emphasis.

Distinguishing the top of zone J1 from zone J was most difficult as their colors and soil consistencies were very similar. On a general level, zone J was slightly less dark, ranging in Munsell terms from hue 10R 3/6 to 10YR 5/6. Furthermore, zone J covered the whole talus slope and reached a maximum depth of almost 58 cm downslope. East and west it was relatively horizontal, but sloped at an angle of less than 30° in the talus. Near the top of the talus, however, zone J became noticeably thinner, and near the 0-0 stake it actually blended into the more ashy zone G. To the west, inside the dripline, zone J blended into the bottom of zone F. I therefore think the zone F occupation inside the cave poured or dumped most of its refuse downslope to form zone J. A number of radiocarbon determinations sug-

gest this occupation occurred at the beginning of the first millennium before Christ; and the bones (mainly jackrabbit) and grinding stones suggest a series of spring occupations. Artifacts were very numerous (about 140) and are much like those of zone J1, suggesting they still were of the Fresnal phase.

Zones J and J1 end the early part of the sequence in the talus of our rockshelter, but they also illustrate a major problem in determining the sequence of the total occupation in the shelter; a problem, I might add, that has come up in many caves I have excavated. That is, the stratigraphy inside the dripline is radically different and much clearer, as well as better defined, than that outside the dripline and/or down the talus. We believe this is true in large part because the surface inside the cave has been drier. As such, no water has filtered down through the stratified layers, upsetting their chemical contents and carrying charcoal fragments down into the different layers to blend into one dark mass or stratum. This phenomenon is what we believe happened downslope; in other words, zones A through D2 of the cave interior have blended together to form a single stratum, zone F+, outside the dripline; interior zones E, E1, and E2 blended together to form zone πJ outside the dripline, while zone F perhaps may have blended and expanded outside the dripline to form zone J and/or zone J1.

The exact stratigraphic positions of zones G, H, and I inside the dripline in squares 0-0 and 0E1 and their relationships to the early zones K and K1 downslope are difficult to determine exactly. This difficulty is compounded by the fact that few artifacts occurred in zones G, H, and I, and there was no datable material. We therefore can do little more than describe the contents of these three zones and then move on to zone πJ of the talus, which clearly connects with zone F that stratigraphically overlays zone G in square 0E1.

Zone I in squares 0-0 (of Beckett's Trench) and 0E1 lay directly on top of zone L, the greenish brown rock fall. It reached a maximum depth of only about 4 cm and covered an area only about 2 m in diameter. In back of the dripline it was orangish brown in color–Munsell 10R 6/8 to 2.5YR 6/10–like some of the zone K1 downslope and outside the dripline. As this stratum extended to the dripline, it darkened in color and not only blended into zones G and H, but became part of those dark brown strata (zones K and K1) that lay in the same stratigraphic position on top of the downsloping rockish zone L. Except for three or four slivers of bones, a core, and three or four flakes, zone I was devoid of diagnostic cultural material that could link it to any of the previously mentioned strata.

Zone I was easily distinguishable from the overlying zone H, which was clearly a pit of dark refuse–the same color as zone J. The pit was basin shaped, about 40 cm in diameter, and reached a maximum thickness of about 15 cm. It contained even less cultural material than zone I.

A grayish layer, zone G, never more than 7 cm in thickness, covered zone H as well as zone I and was about 1.2 m in diameter, with its center at about square S0.12E0.20. It contained six bones and eight chips. As it extended past the dripline it darkened and blended into zone K. Inside the dripline, however, zone G clearly was under zone F, and outside the dripline it was under zone J. These strata truly were well-documented horizon markers.

Zone πJ, down the talus slope, was dark brown in color, Munsell hues 10R 3/4 and 3/4, 2.5YR 3/4 and 4/6, 5YR 4/4, 7.5YR 3/2, and 10YR 3/2. It was relatively sticky or clayish with occasional pieces of charcoal. It had a few burned areas in it, possibly remains of hearths. In the main it was devoid of features, and its artifacts and ecofacts had no uniform position. In thickness zone πJ varied from a few (5-10) cm at the dripline where it connected with zone F, to 75 cm (almost 1 m in places) at the northern extension of the excavation. Generally speaking, zone πJ not only thickened downslope, but sloped downward roughly parallel to the surface at about a 30° angle. Much of zone πJ came down (was dumped, poured, or eroded) from zone F. It was loaded with ecofacts (5,000) and artifacts (about 442, of which 173 were notched bone beads found with burial 6). These artifacts were the initial basis for our defining the Hueco phase. A number of radiocarbon and obsidian hydration dates also indicated the zone was deposited over a long period, roughly from the first millennium before Christ to the early centuries after that time. The bottom of zone πJ definitely connected with zone F, which was like it in content but darker in color, while the top blended into zones E, E1, and E2, which were totally unlike it in content and color.

From many standpoints, zone F was the bottom occupational zone above the greenish gray rock floor of the cave, zone L. It was very dark in color and full of charcoal, roughly 5R 2/1, 5YR 2/1 to 10YR 3/1 on the Munsell scale. Zone F also had flecks of rotted vegetation in it and was roughly horizontal, all of which suggests it was a stratum of human refuse. The zone varied in thickness from 1 cm to a maximum of about 30 cm, but the thicker portions could have been some sort of shallow, poorly defined refuse pits or basins. Three quite well defined pits, roughly 30 cm in diameter and 10 cm in depth, occurred, as did four burned areas that probably were hearths. Artifacts were relatively

rare (22), as were ecofacts, but the diagnostic ones belonged to the Fresnal phase. No materials were directly dated, but I suspect zone F roughly is contemporaneous with zones J and J1 downslope.

Almost everywhere inside the dripline zone F was capped by zone E, a relatively thin layer of greenish gray roof fall with lenses of small flakes of rock. In Munsell colors this zone ranged from brownish yellow 10YR 6/6, 5Y 3/6, 7.5Y 3/6 to 10Y 4/4, 7.5Y 3/4. The layer was roughly horizontal and varied from less than 1 cm in thickness to almost 20 cm. To the east there were occasional small and thin horizontal lenses of charcoal with a chip or two in them, suggesting occupation was occurring during zone E's deposition. To the west, about 4 cm from the bottom of this zone, one of these lenses thickened into a charcoal stratum, zone E1, about 2-4 cm thick, an obvious floor of an occupation. It contained seven Hueco artifacts and about 20 ecofacts (chipped bone and vegetal material). The zone above it we considered to be zone E, while the 5-cm lens of green rock roof fall below it was called zone E2. Along the dripline all these zones blended into the top of the dark brown refuse of zone J and probably were roughly contemporaneous with it. Zones E, E1, and E2, like zone F (and G, H, and I), thus were phenomena that occurred inside the cave; they had a vague connection to strata outside the dripline and down the talus and were represented meagerly by artifacts or features. In this they were different from the overlying zones, which had many potsherds and better-defined features. In fact, generally speaking, our preceramic strata inside the cave were overlaid distinctively by a brown refuse layer about 20 cm thick and containing many chips and sherds.

Initially, when we cleaned out Beckett's Trench, this horizontal brownish refuse stratum was called zone D, but even the preliminary study of the 0-0 north-south profile revealed fine stratigraphic divisions within this layer or zone. These divisions varied in thickness and content from one part of the cave to the next.

The lowest part of this stratum to the west was a distinguishable dark brown stratum, zone D2 (Munsell 10YR 4/4, 2.5Y 4/4, and rarely 5Y 4/4). It was both sandy and clayish with many flecks of charcoal and rotted vegetational materials. To the west it reached a maximum thickness of about 15 cm and covered an area of roughly 5 by 4 m, from S1W0.65 to S3.5W4.5 and from S0.5W3 to probably S4.5W3. Zone D2 had three or four pits in it and at least three hearths. It was full of sherds, mainly of the Mesilla phase, and had about 202 artifacts. Although not directly dated, sherds suggest occupation (or occupations) occurred in the latter half of the first millennium of our era. Zoological seasonal indicators suggest a late spring-summer set of occupations, but whether these were brief hunting or plant-collecting forays or agriculture-planting visits is difficult to determine at this time.

The next stratum, zone D1, overlay zone D2 in the southwest portion of the dig, but to the northwest it overlay zone E. It extended from about S3E1.7 to S3W4.45 east-west and went from about S0.85W1 to S4.5W1.5 north-south. A distinctive strata, never more than 3 cm thick, it was made of fine, hard clay. In color it ranged from Munsell hue 5YR 7/8 to 7.5YR 7/10 to 10YR 8/8 and 2.5Y 8/10. The surface of zone D1 was very flat and showed polishing or scratches, while its underside was irregular and often cemented into the surface of zone D2. We believe this floor was made by the occupants, who brought in wet clay from the arroyo bed, plastered it on zone D2 in the back of the cave and let it dry. Originally we thought it had been burned, but except for a shallow pit centered at S2.75E0.5 and about 1 m in diameter, charcoal tests proved otherwise. We found a few sherds on top of the zone, mainly brownware, but some were stuck in its surface, including an El Paso Polychrome sherd. We therefore believe this floor was constructed by being walked over and lived on by people of the El Paso phase, roughly A.D. 1100-1300.

Capping the floor of D1, as well as zones D2 and E1 in the front of the cave, was a 5- to 20-cm layer of brown refuse containing much charcoal and vegetal materials, the true zone D. It was found inside the cave and blended into zone F+ outside the dripline and down the talus. Zone D was much like zone D2 in color, ranging from Munsell's 10YR 4/4 to 5Y 4/4. It had four hearths on it as well as three pits dug down from it and was loaded with sherds, artifacts, and ecofacts, including four Pueblo corncobs. This was the refuse of the El Paso people during the occupation on the clay floor (zone D1), in the period from roughly A.D. 1100 to 1300. It represented our final prehistoric occupation of the cave.

Over zone D was zone C, a thin, silty and sandy layer, never more than 3 to 4 cm thick, occurring mainly in the back of the cave. It was yellowish in color (Munsell 10YR 8/8 to 2.5Y 8/10), contained glass, metal nails, and animal (burro and horse) manure, and obviously was of Historic times. However, zone C did contain sherds, including some Apache ones, and obsidian chips that dated to A.D. 1625 and 1675. Thus the Apache may have visited our cave, and burial 8 may have been one of their reasons for using the shelter.

The other two top layers inside the cave also were Historic, but without occupations by native peoples. Zone B, never more than 10 cm thick, had a large amount of vegetal material, much of which was animal (horse or burro)

dung; extending down from it were at least three post holes, with partially preserved posts, suggesting the shelter was used as some sort of corral, perhaps contemporaneous with the foundation ruins above the spring that were built and used somewhere between 1850 and 1910.

Over all of these in the interior of the cave south of the dripline was zone A, another 10-cm layer of very modern refuse of brown, silty soil. Beyond the dripline all of these interior layers, from zone A to zone D2, blended together to form zone F+, about 20 to 30 cm thick at the dripline, deepening to as much as 70 cm down the talus slope. This zone contained sherds as well as artifacts, but Historic materials never were found deeper than 20 cm. Study of the sherds at various arbitrary levels in various squares within this nebulous zone indicates a tendency for the El Paso phase types to be above Mesilla types, thereby confirming the stratigraphy at zones D and D1 over zone D2.

Summary

All in all, the careful and well-controlled excavation of Todsen Rockshelter revealed a long stratigraphic column and chronology of culture materials that serve as the basis of a sequence of culture phases. These phases, from early to late, were as follows:

Zone A	–	dark modern refuse: Modern, A.D. 1900-1985
Zone B	–	vegetal refuse: Modern, A.D. 1850-1900
Zone C	–	silty clay strata: Apache, A.D. 1520-1772
Zone D	–	brownish prehistoric refuse: El Paso phase, A.D. 1100-1300
Zone D1	–	puddled clay floor: El Paso-Doña Ana phases, A.D. 900-1100
Zone D2	–	brownish refuse: Mesilla phase, A.D. 250-900
Zone F+	–	dark refuse in talus (zones A-D): Ceramic phases, A.D. 230-1985
Zone E	–	lensed rock fall: Hueco phase, 300 B.C.-A.D. 250
Zone E1	–	charcoal floor: Hueco phase, 100 B.C.-A.D. 100
Zone E2	–	lensed rock fall: Hueco phase, 300-100 B.C.
Zone πJ	–	dark brown refuse in talus (zones E-F): Hueco phase, 850 B.C.-A.D. 250
Zone I	–	orangish refuse: maybe Gardner Springs phase, 6000-4000 B.C.
Zone F	–	charcoal-filled refuse: Fresnal phase, 2500-850 B.C.
Zone J	–	brownish refuse in talus (zone G?): Late Fresnal phase, 1160-850 B.C.
Zone J1	–	dark brown refuse in talus (zone H?): Middle Fresnal phase, 1600-1160 B.C.
Zone G	–	lens of ashy refuse: maybe Keystone phase, 3800-3600 B.C.
Zone H	–	pit of dark refuse: maybe Keystone phase, 4000-3800 B.C.
Zone K	–	orangish refuse (zone I?): Keystone phase, 3800-3600 B.C.
Zone K1	–	charcoal-filled refuse (zone I?): Gardner Springs phase, 6000-4000 B.C.
Zone L	–	greenish rock fall: maybe Angostura, 8000-6000 B.C.
Zone M1	–	lensed sand: maybe Folsom, 8000-7000 B.C.
Zone M	–	sand: maybe Folsom, 8000-7000 B.C.
Zone N	–	loose, light gravel: 10,000-8000 B.C.
Zone N1	–	compact, heavy gravel: more than 10,000 B.C.
Zone O (N2)	–	rock floor of cave

Further support for our definition of these phases came from our excavation of Tornillo Rockshelter in the Organ Mountains.

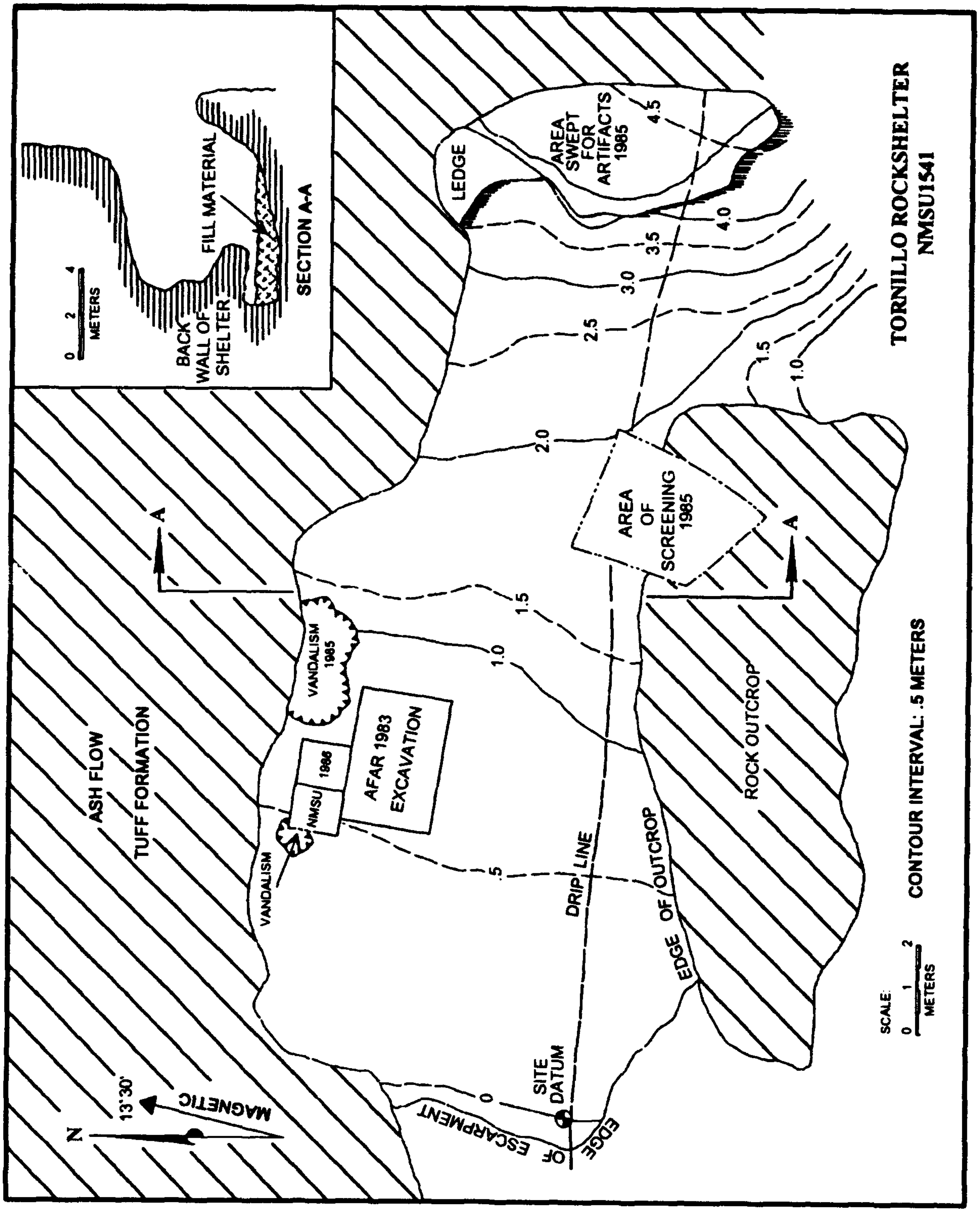


Figure II-3a. Contour Map of Tornillo Rockshelter (NMSU1541)

Tornillo Rockshelter–NMSU1541 (LA17687)

Tornillo Rockshelter (NMSU1541) is located at the extreme south end of the Organ Mountains. Its map position is in southeastern Doña Ana County, Township 24 South, Range 3 East (see Figure II-3a). Tornillo Rockshelter Sections 13 and 14–U.S.G.S. Bishop Cap 7.5 in Quad–longitude 106° and latitude 32°13'33" (see Figure II-3a). The rockshelter is about 4,832 feet above sea level on a steep slope in the second tier of cliffs, well below the summits to the north, which rise up to 5,535 feet, but the shelter is above the surrounding plain to the south and east, which is at 4,500 feet.

This small shelter is in the pinkish rhyolite of the Organ Mountain formation and is immediately north of Bishop Cap, which is at the extreme north end of the Franklin Mountain formation. Between the two ranges and immediately in front of the cave is a basinlike pass that connects the Rio Grande drainage to the west with the Tularosa Basin on Fort Bliss to the east. Tornillo thus has a magnificent (albeit windy) view of the surrounding terrain.

Environmental Niches

The lower basin, or pass, has the upper Bajada-type vegetation or thorn forest–characterized by creosote bush (*Larrea tridentata*), lechuguilla *(Agave spp.)*, ocotillo *(Fouquieria splendens)*, prickly pear, datil yucca *(Yucca spp.)*, and sotol with occasional mesquite, whitethorn acacia, saltbush, and low scrub. The slope on which the cave is situated has the alluvial slope type of vegetation with more opuntia and lechuguilla surrounded by shrubs of small-leaf sumac, mesquite, desert willow *(Chilopsis linearis)*, hackberry *(Celtis spp.)*, datil yucca, sotol, bear grass *(Nolina spp.)*, and an occasional juniper *(Juniperus spp.)*. Above it is mountain vegetation with juniper, desert willow, and oak *(Quercus spp.)*.

As is obvious from the vegetation, rainfall is limited (less than 500 mm); most of it falls in the late summer and fall when temperatures are hot. Winters are relatively mild, but we can verify from our work in the cave from February through April that there are occasional frosts, a couple of days with snow, and many days with a fierce, biting wind. In terms of periods of human occupation, rainwater collects in holes in the rock in late summer, and many of the plants reach fruition then. As Upham points out, on the basis of analysis of materials from the excavation of his two rockshelters in the Organ Mountains, as well as the data from ours,

> *At the present time there are strong indications that the primary use of the rockshelters occurred during the midsummer and fall of the year. This supposition is based on two sets of information. First, the recovery of mesquite pods and beans, tornillo beans, yucca seeds, juniper berries, pinyon nuts, hackberry seeds, and tuna fragments and seeds may indicate that gathering of these resources in the area coincided with occupation of the rockshelters, that is, between July and early October. This inference is bolstered by the recovery of maize, beans, and squash, which can be harvested between July and late October in the Jornada area.* (Upham, NSF Grant Proposal, 1975)

Digging Technique

Located about 100 m (300 feet) above the thorn forest plain, Tornillo was reached by walking diagonally across the talus slope to a steep arroyo that cuts through the first tier of cliffs, about 9 m (30 feet) high, to the talus of the second cliffs, and then along the bases of those cliffs, about 15 m (50 feet) high, to the relatively level floor of the rockshelter. The cliffs overhang the floor area to a maximum distance of slightly more than 9 m (about 30 feet). The west portion of the shelter has a relatively level floor–about 10 m (E-W) by 8 m (N-S)–but the south edge is ringed by rock fall that lies above the steep talus slope. In about the middle (east-west) of the cave, the floor starts to slope gently upward for about 4 or 5 m, and a path leads out of this area down the talus; east of this area are two steep meter-high steps to the eastern rock wall of the cave. This east half of the cave had little or no deposits on it. We therefore dug in the west portion and used the east for screening and sorting.

It was a rough walk up to work, which makes it easy to understand why there was limited prehistoric occupation even in the western part of the shelter where the floor is level.

However, we were encouraged to dig by a looter's hole against the back wall (made in 1984, after the Bureau of Land Management [BLM] had been informed we were to excavate the shelter); this intrusion indicated the refuse might be more than 1 m deep. In addition, the backfill contained fragments of baskets, string, and primitive corncobs, showing the shelter had been occupied in ancient times.

In August of 1984 I visited the area on the invitation of Upham, and saw the artifacts excavated by him and his classes at NMSU in 1983 and 1984. The collection included primitive preserved corncobs as well as Archaic artifacts. They indicated fine archaeological potential for a key part of the Southwest where the Archaic was relatively unknown. Upham invited me and AFAR to join forces with him and his class in the winter and spring (spring semester) of 1985 and assigned Tornillo to the AFAR group under the overall direction of myself. In charge of the excavation were Laura Leach-Palm, then a graduate student at Boston University, who stayed the whole season, and Bob Swain, who was with us the first half of the season. Working with them were two students, Gail Bockley of Tufts University and Carroll Conquest of Boston University. Kitty Lou Pope and Peggy Wilner acted as lab assistants, and Jim Pope served as administrator. This basic crew was aided for brief periods by a series of Friends–Jane Libby, Libby Cook, Babs Staniford, Barbara Dobbs, Jennie MacBean, Tom Moody, Steve and Adam Halem, and Adam Smith. Not only did Jennie and Barb work at the dig after the torturous climb, but they drew our artifacts. All the Friends made financial contributions that were crucial for our research in the field.

Because we were working in conjunction with Upham, we decided to use his complex recording and notetaking system and his field techniques. This system looked perfect on paper, but it created problems in terms of field techniques and operations.

Upham's test squares in the Organ Mountain sites usually were 2 m in size and were excavated in arbitrary 5- or 10-cm levels. These arbitrary levels mainly were used because no stratigraphy seemed readily apparent. In Tornillo, thanks to the looter's hole, this use of arbitrary levels was not necessary. When the wall was cleaned before excavation, a top layer of fine roof fall (zone A) was revealed above a layer of refuse (zone A1). These two zones lay above a 10-cm layer of fine roof fall (zone B), and another dark layer with vegetal remains, including two tiny corncobs (zone C, floor 2), which lay above more fine rock scree (zone D) on top of the cave floor. The stratigraphy was very fragile; the refuse was loose and the walls did not hold up well. We therefore used methods that were rather different from those of the rest of the class.

Initially, we put down tests in two diagonal squares, N4E1 and N5E8, by stripping off actual strata. We dug the two test squares to level 4 and then drew all profiles so we would have a record of the stratigraphy, which now showed a top layer of scree (zone A), a horizontal rock layer called feature 1, and more scree (zone A1) above a vegetal floor 1. With these profiles as a guide we set about stripping off the actual strata from two faces in the adjacent squares, N5E7 and N4E8, following the same meticulous methods. All artifacts (mostly vegetal), chips, and plant remains were mapped *in situ* to make a floor plot for each stratum.

The same system continued down through zone B under floor 1 and through zone C to floor 2. Since the sloping and delicate walls of the squares increasingly made it difficult to dig, we extended the trench half a meter east and west, stripping strata from a vertical profile of N4E6 and half square N5E8.5. The in-between squares, N4E8.5 and N5E5, were trowelled off in a similar manner. This process gave us room to excavate to the rock floor through zone D, using the La Perra alternate square system. The stratigraphy seemed to be dying out in the west part of the cave, as well as in the final squares toward the back (north) wall (N6E7). (In 1987, during Upham's final class season, a 3-m-long trench was excavated parallel to our west end, using arbitrary levels, but little except an arrow shaft and Pueblo corn was found, and the stratigraphy seemed to be mainly zone A.)

Refuse other than artifacts was removed by dustpan and bucket and screened through window screen, a process that took hours. The seeds we recovered were bottled and catalogued by type. From each square and level 1-liter plastic bags were filled with samples for pollen, soil, and flotation analysis. The flotation samples (500 cc volume) all were fractionated using an elutriator provided by the Department of Agriculture, State of New Mexico. Normally, the elutriator was used by agricultural scientists to recover nematodes, extremely small parasitic worms, from soil. Fractionating our flotation samples enabled us to recover an estimated 95 percent of the organic material in each sample. Analysis suggested, however, that the majority of the seeds probably were deposited by nature, not by humans.

All in all, we did not find many artifacts at Tornillo; those we found were perishable items mostly, not lithic or ceramic remains. In fact, only a single sherd was recovered in zone A (during Upham's final season), while a sherd of brownware was found on the talus. On the other hand, we recovered a large amount of foodstuff remains, including quids, corncobs, gourds, and squash.

Further, seeds by the tens of thousands were recovered from our fine screening and flotation. These remains gave us evidence of a sequence of subsistence systems if not culture systems. Dating of artifacts from each of our stratigraphic zones allowed these artifacts to be correlated with culture phases yielding more abundant artifacts from other sites with dated stratigraphy.

Stratigraphy

Figure II-3b shows the stratigraphy of Tornillo Rockshelter, from the rock floor to the surface. Above the rock floor of the cave was a thick layer (20 to 40 cm) of fine soils, composed both of grains eroded off the rock cliff and eolian silts cementing in the fine rhyolite flakes that eroded off the walls and roof of the cave. This layer, zone D, was full of seeds; delicate and large plant remains, including quids and feces; and bones of rodents and other animals. Among the plant remains were eight corncobs–four Chapalote and four Proto-Maiz de Ocho–and one brown corn kernel, probably from a Chapalote cob. We believe these corn remains were brought in from people's homes elsewhere, for analysis of pollen from the site revealed no corn pollen. Used for carbon 14 analysis, these cobs yielded a date of 1225 B.C. The other remains of a domesticated plant were gourd rinds, possibly of *Lagenaria* sic. We also recovered a number of sticks; 16 knots and fiber coils and braids of cactus leaves; string and cord; as well as six chips. Although these artifacts tended to appear in the upper part of the stratum, they did not occur on a floor or any discernible occupational level and could have been deposited over a number of centuries. The date of the corncobs suggests the deposit occurred at the time of the Fresnal phase, but part of it could be dated much earlier. The ecofacts suggest a late summer-early fall set of forays into the caves, and the artifacts suggest these brief visits were for plant collecting (opuntia and lechuguilla leaves or seeds), and that the collectors brought their food (lunch) such as cucurbita and corn from their homes elsewhere.

Zone C was little different in content, but was much thinner–less than 10 cm deep–and had a heavy vegetal content that made it slightly darker in color. The upper part, dense with vegetal material, was designated floor 2. Almost all the plant remains recovered, including Chapalote and Maiz de Ocho corncobs and cucurbita rinds as well as the perishable artifacts, came from floor 2–usually at excavation level 5 or 6. While the lower part of zone C may have been deposited mainly by natural means, the floor looked like an actual occupation by some sort of a task force in the late summer or early fall of the year. The dates on the overlying zone B and underlying zone D, as well as the style of a sandal, suggest zone C belonged to the Fresnal phase, probably some time in the early centuries of the second millennium before Christ.

Above floor 2 was zone B, a layer of pale brown soil mixed with small flakes of rhyolite from the overhanging cliff. It contained artifacts and vegetal material, but provided no definite evidence of a floor or occupational levels. One obsidian chip from this layer gave a date of 900 B.C., suggesting any forays to Tornillo at this time also were of the Fresnal phase. This assignment is confirmed somewhat by the finding of the base of a Nogales-type projectile point or knife, which may have been used to cut opuntia or lechuguilla leaves during summer or fall plant-collecting forays.

Overlying this natural stratum B was floor 1, a few centimeters thick, composed mainly of vegetal material and perishable artifacts. This floor blended into zone A1 in the south, east, and west ends of our excavation, where it was a small refuse patch only about 2 or 3 m long and 1.5 m in maximum width. An obsidian chip from this floor gave a date of 548 B.C., suggesting its occupants were of the Hueco phase. Its few artifacts and ecofacts suggest the cave was used during a summer-fall plant-collecting foray or forays. Interestingly enough, the "lunch" the collectors brought with them from their homes included not only Chapalote corn (three cobs), but a cob of Maiz de Ocho and Pima-Papago races.

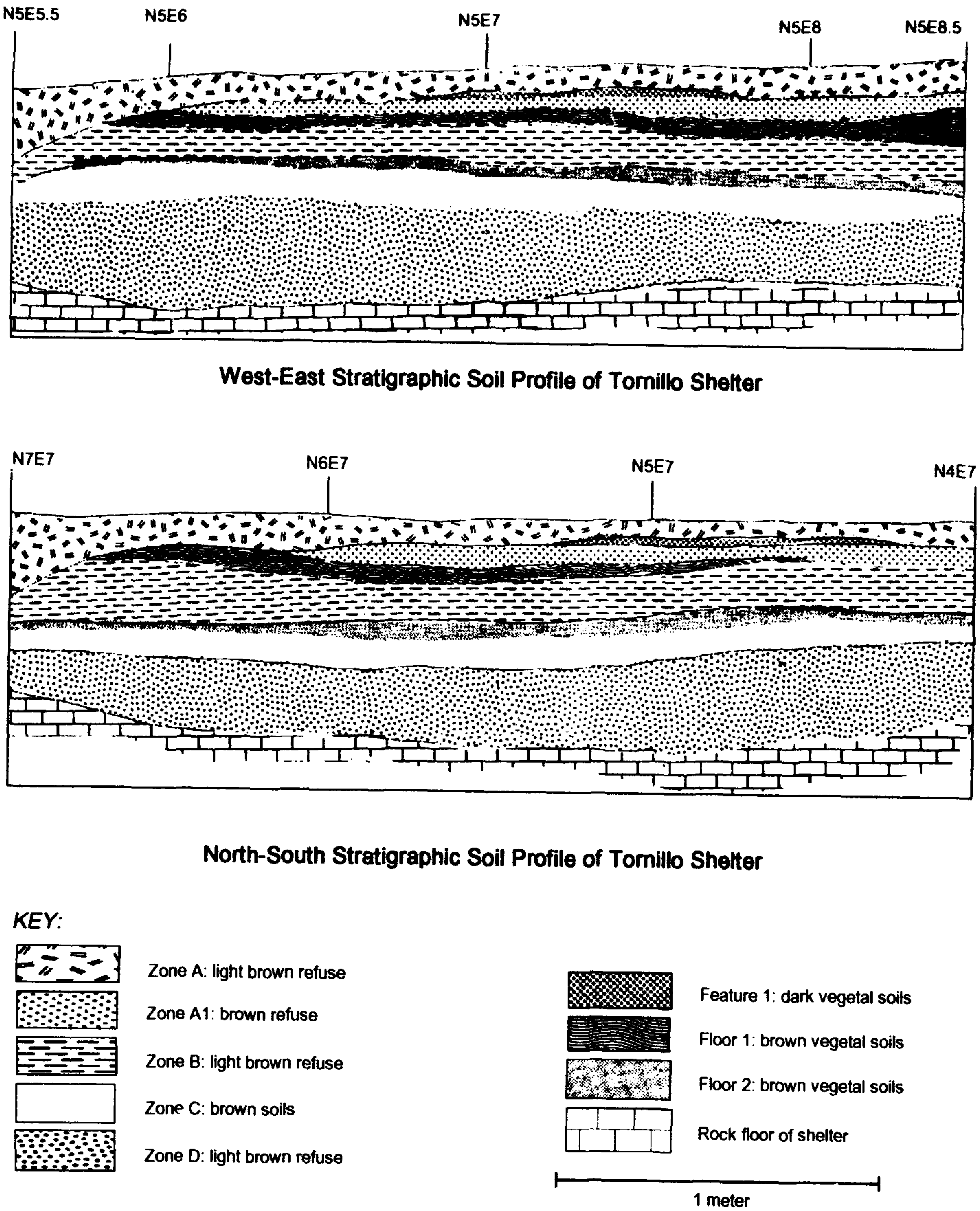


Figure II-3b. Cross-sections of Tornillo Rockshelter

Over the flaky layers of zone A1 in one spot was a small patch (1 m in diameter) of vegetal materials under 11 or 12 thin slabs of rock that we called feature 1. Containing a few knots, or carrying loops, and remains of foodstuffs, it seems to reflect another brief summer-fall foray by task forces.

Overlying feature 1 was zone A, a nebulous 10- to 20-cm layer of rock flakes and soils that thickened to the west and north. From it we recovered an arrow shaft and other perishable artifacts (and Upham later recovered a sherd), suggesting it was occupied after the Archaic period. Although this seemed to indicate some sort of a visit during the El Paso phase, A.D. 1100-1300, some of the deposition may have occurred both before and after that time. The knots, string, and carrying loops found were the sort used in plant collecting, and the seeds again suggest a summer-fall set of forays by task force groups.

Summary

Although the occupations in the eight stratigraphic units of Tornillo were monotonously the same–small plant-collecting forays in the late summer-early fall by task force groups–our excavation at Tornillo gave us new knowledge of some of the perishable artifacts belonging to the Fresnal and Hueco phases. In addition, Upham found similar data and also recovered a few rare diagnostic artifacts in his four seasons of excavations in other rockshelters in the Organ Mountains. More importantly, the work in the Organs gave us a sequence of maize races. From Tornillo and the other Organ Mountain shelters come indications of a sequence that begins well before our earliest date (1225 B.C.), when Chapalote corn arrived from Mesoamerica (dated at about 2000 B.C. in Roller Skate). Between 1225 and 548 B.C. the local inhabitants bred a new type of corn, Proto-Maiz de Ocho, that in turn developed into Maiz de Ocho, which spread all over the Southwest and perhaps into the eastern United States. Proto-Maiz de Ocho also occurred in the ancestry of Pima-Papago corn that became prominent after the time of Christ. Finally, Pueblo corn arrived in the area (Upham et al. 1987).

Thus, in spite of the seemingly meager cultural remains, these significant results made our research worthwhile. Excavation at Todsen Rockshelter helped us define the perishable remains found in our last two preceramic phases, Fresnal and Hueco. At nearby North Mesa we expanded our knowledge of the Early Archaic.

North Mesa–LA5529

North Mesa (LA5529) is located at longitude 106°55'62" and latitude 32°21'31" in the southwest quarter of section 35, township 22, south R1 west of New Mexico principal meridian in Doña Ana County. With a floor elevation at about 4,548 feet above sea level, the site is on the top of a ridgelike mesa between the headwaters of Spring Canyon, the north fork of Box Canyon, and the south fork of Apache Canyon. North Mesa is about a half mile northwest of Todsen Cave in Spring Canyon (see Figure II-4).

Basically, the site is on a ridge composed of sand over solidified Pleistocene clays and gravels on top of volcanic felsitic floors of the Oligocene. Its refuse extends over an area about 100 to 120 m east-west and 40 to 50 m north-south. In our 1988 and 1989 excavations we found the top sandy refuse layers to be at least 1.63 m deep; future excavations undoubtedly will find deeper sections.

Environmental Niches

This mesa-top location, with its sandy soils and exposure to windy winter blasts and limited rainfall (less than 8 inches per year), helped to determine the vegetational cover. North Mesa is dominated by prickly pear, with grasses, yucca, whitethorn acacia, sotol, saltbush, and occasional mesquite trees, one of which we used as a sun shelter. All of these plants yield foodstuffs in the wet summer and late spring months when animals such as mule deer, antelope, jackrabbits *(Lepus californicus)*, and various reptiles (including many lizards and rattlesnakes) abound. In fact, the location provides an excellent lookout for game. In the Pleistocene and Early Holocene, when herd animals were numerous, North Mesa may have been an even better summer hunting station. Our zoological studies are not complete enough to determine whether the many occupations were of that season, but the numerous grinding stones suggest they

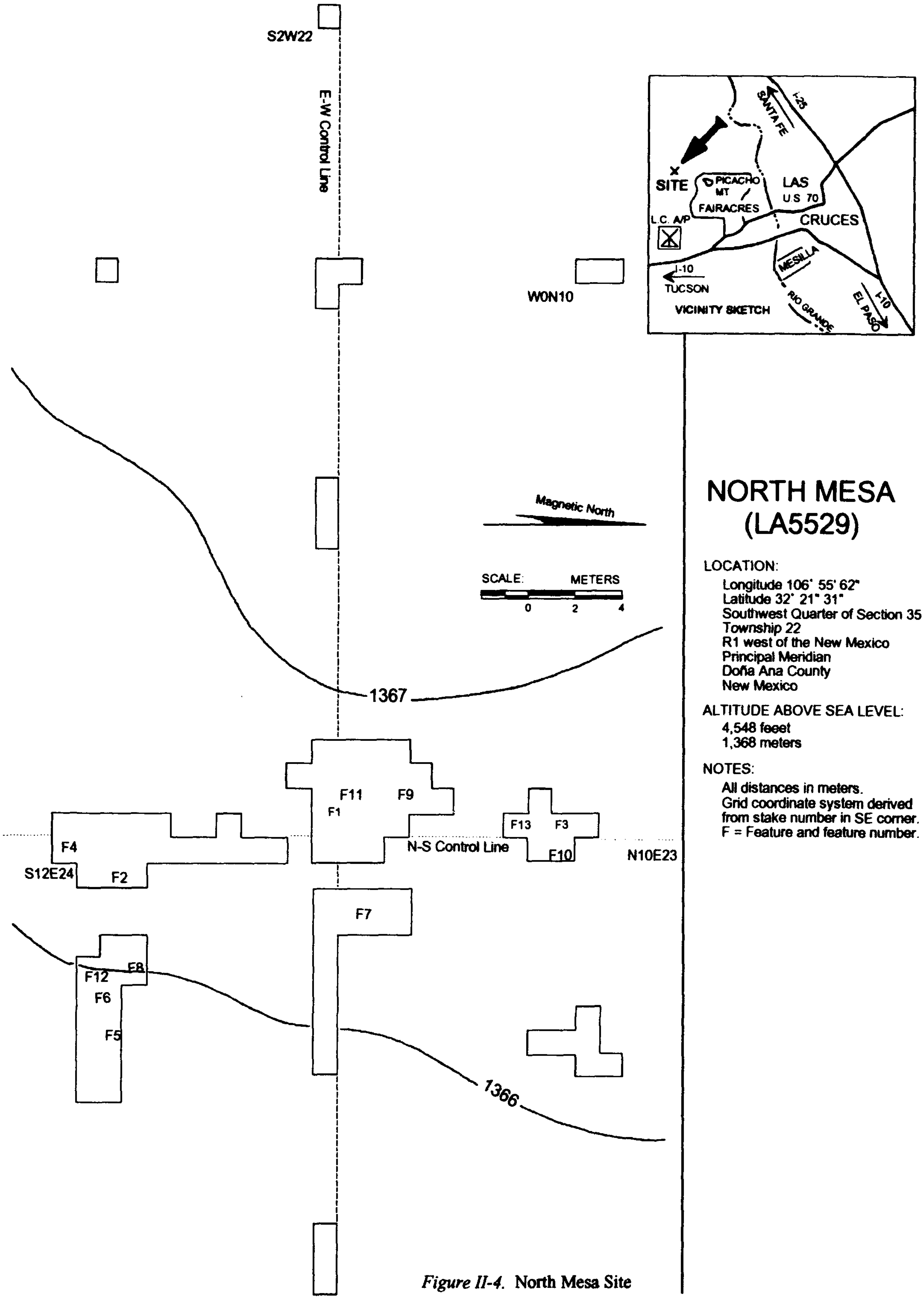


Figure II-4. North Mesa Site

were. A brief study of the site by Dr. John Hawley, geologist at New Mexico School of Mines in Socorro, suggests the vegetation has changed little since and even during the Pleistocene (Gile et al. 1981). Many ecological studies of the site are forthcoming, so present conclusions must be considered only tentative. In contrast to nearby Todsen Cave, with its late winter-early spring occupations, North Mesa seemed a likely place for late spring-summer-fall occupations. Also, the mesa is only about 6 miles from the Rio Grande riverine ecozone and nearby Chavez Cave, which would have been a prime winter occupational locale.

North Mesa has been a prime area for surface collecting for many years, and Beckett's major surface collection of artifacts, mainly projectile points, was the basis for his master's thesis at Eastern New Mexico State University (Beckett 1973). He noted that the artifacts suggested mainly Early and Middle Archaic occupations. During our 1986-1987 excavations in nearby Todsen Cave, we made more surface collections at North Mesa, and it became apparent that Early Archaic levels represented meagerly at Todsen were represented amply on North Mesa. Thus plans were made to test the area in 1988.

Digging Technique

After making a rough contour map and taking pictures of the site, our first task was to set up 1-m test squares along an east-west axis, which seemed to cut through the main portion of the site as indicated by our surface collection. In the best dicta of the New Archaeology (Binford 1964), plotting of these artifacts indicated the "best and most" occupations were in the west end of the site (although my basic archaeological instincts signalled otherwise), so we dug square S1W10 first as well as S1-0. Following these sampling techniques of the New Archaeology, however, turned out to be unproductive and a waste of time, energy, and money (Mayer-Oakes and MacNeish 1964).

1988 Season

In terms of stratigraphy, square S1W10 revealed three zones: Zone A–about 20 cm thick–of loose humus and recent dune sand overlying dark sandy refuse, zone B–about 30 cm thick–which blended into reddish clayish rocky deposits that became the underlying rock base of the mesa, zone X. We dug the square by trowel, designating zone A as level 1, followed by three arbitrary 10-cm levels in zone B, and two in zone X. All artifacts and ecofacts were plotted *in situ*, the datum depth was taken from a pole placed at point N1E10, and square descriptions were recorded about soils, artifacts, and other matter for each level. The removed soil was put (often pounded) through a 1/4-inch screen.

The second square, S1-0, was dug in similar manner and stratigraphically was much the same; however, zone B thickened slightly toward the east and a thin layer of light sand, zone C, appeared below it. Later we dug S1E1 and square 0-0, but these were dug from vertical profiles; each stratum or level was stripped from a vertical face in these opposite squares. While our digging control and recording were meticulous, artifacts were few and far between.

Our personnel in these endeavors directed by me were Crew Chief Bob Smith, Editor Jane Libby, Laboratory Chief Peggy Wilner, and student Kevin King, who sometimes were joined by NMSU students Steve Scheel and Rachel Green. Late in the season various Friends of the Foundation–Don Chrisman, Tom Moody, Richard Lederer, Barbara Dobbs, and David and Mimi Horner–joined us for short periods. Generally speaking, however, our crew was small.

Surface artifacts hinted S10-0 and N10-0 were possible "hot areas," so tests also were put in them but never were completed because zone B in each was even thinner and less productive than squares dug earlier. From February through March we concentrated on the eastern squares. The first of these, S1E11, was dug down to about 60 cm by arbitrary 10-cm layers from above. S1E12 was dug by a modified La Perra technique by stripping off its strata and levels from a vertical profile. Artifacts and ecofacts were slightly more numerous, including an Early Archaic occupation in the humic zone A, and zones B and C both thickened toward the east.

Our next two squares, S1E11 and S1E12, were dug in a similar manner with a similar thickening of zones B and C noted. Just below the dark sands in zone B, about 5 to 10 cm into the light sand of zone C, we began to find small slabs or sherds of rock, which we designated feature 1, lying horizontally at about 1.20 m, where zones B and C were about a half meter thick. A few more artifacts were found in zone B as well as a feature of zone C.

In S1E32 and S1E22, zone A was a real sand dune, almost 30 cm thick with lenses of humuslike vegetal (opuntia leaf) materials. Zone B was about the same thickness, but in the east of the trench (dug from a vertical profile), zone C thinned out and the rock floor was only about 1 m from the surface. It looked as if we were getting to the east end of the deposit. To make sure, we dug squares S1E43 and S1E44 and found that zone B diminished noticeably in thickness (about 30 cm) to the east and zone C pinched out to 10 cm. The rock floor was turning up at about 60 cm, just like our westernmost square, S1W10.

Through these test squares we had roughly defined our east-west stratigraphy, and we turned to the north-south dimensions as the generally discouraging season was coming to a close. Since S1E21 and S1E40 had the deepest stratigraphy, we next dug squares N10W41, N10E24, S11E23, and S11E41. All but N10E41 turned out to have interesting features and deep stratigraphy.

At a depth of about 70 cm, at the juncture of zones B and C, S11E41 had a pavement of rock slabs–feature 3–and zone C went down to 80 or 90 cm. This indicated distinct possibilities of a Middle to Early Archaic occupation, and further excavation was carried out in the 1989 season. N10E24 had a fire pit, feature 4, in the lower part of zone B, which we did not excavate in 1988.

Even more interesting was S11E23; here the humus and refuse directly underlay our greatest concentration of sherds, seven Alma Plain. More importantly, the sherds overlay a burned floorlike area we designated zone B1. Its few artifacts seemed to be Middle Archaic (Fresnal phase), but could be more recent. Below the floor was about 40 to 60 cm of dark zone B, and in its lower part was a large 2- by 1.5-m rock-filled pit about 30 cm deep, which we called zone B2 and feature 2. We dug out this feature completely, mapped its stratigraphy, and sent a sample of its charcoal for a radiocarbon date. A point and scraper suggest the feature is of Fresnal phase times, 2500-1000 B.C. Just to the south of it and below it, in the lower 5 cm of zone B, we found another burned patch, zone B3, which extended into the south wall of the trench and was excavated in the 1989 season.

Because we wanted to uncover feature 2, the burned rock pit in zone B2, we extended the 2-m trench northward from S11 to S6 (see Figure II-5). Zone C, which was only 10 to 20 cm deep in the south end, gradually thickened in the north to almost 40 cm, while zone B stayed about 50 to 60 cm. Although no more features were found in it, artifacts–including a Clovis point–and ecofacts were fairly numerous. Because of these finds, we decided to concentrate our 1989 efforts on the southern area between S11 or S12E20 to S12 or S13E42 or E43.

While we were digging out the southern roasting pit in 1988, we expanded our S1E21 and S1E22 trench to uncover more of the rock pavement, feature 1, in the top of zone C. It extended into both S1E23 and S1E24 as well as 0E23 and 0E24. Artifacts found in it included a Bajada point, which indicated an Early Archaic occupation. In 1989 we excavated to the north to find more of this occupation. In the excavated region the dark sandy zone B thickened to 70 to 80 cm; to the north, zone C thickened to 1.30 m. Further, right along the north wall, at a depth of about 1.30 to 1.40 cm, there was a dark stratum with a few chips and a graver, which may be a Clovis occupation.

This stratum overlay another 10-cm-thick brown sand layer on top of the rock floor at 1.53 cm, which we reached on the final day of our 1988 excavation. (All these features and their possible significance are further described in Chapter V, which concerns culture contexts.) Although most of the features and our 266 lithic artifacts, sherds, and ecofacts were found late in the season, the stratigraphy was clear cut and worthy of further investigation. A summary of the strata, from bottom to surface, follows.

Stratigraphy

In the lowest strata the Pleistocene lake gravels and clays were cemented into the Oligocene shales. Over these strata were wind-blown light brown sands. The earliest of the strata was designated zone E. It was only about 10 cm thick and occurred in a limited area in S1E20 to E23 and feature 1, but may extend north of that area. No cultural material was found in it; its position under zone D, with its possible Clovis remains, suggests the stratum was deposited in the final part of the Pleistocene, before 11,000 years ago.

Zone D, a 1- to 5-cm layer of dark brown sand refuse, extended southward from the north wall of square 0E23. It was only about 60 m long east to west, and 40 cm deep north to south from the north wall of square 0E1. Its six chips and graver suggest it is some sort of occupational layer that perhaps is connected with the two fragments of Clovis

points we dug up in later deposits. If so, then this zone dates somewhere between 11,000 and 12,000 years ago.

Overlying zone D in the center of the site–but over the rock floor elsewhere–was light brown sand, zone C, which pinched out along the edges of the area excavated in the central pit. In the central area of S1E23, feature 1 contained a few possible Gardner Springs artifacts, which should date the end of this depositional period as somewhere between 6,000 and 8,000 years ago, although it may have begun some 11,000 years ago. Future excavations, particularly in the central region where zone C is almost 1 m thick, could reveal other occupations by earlier (Folsom-Angostura) cultural phases.

Over these earlier, culturally impoverished layers was the distinctive dark, almost greasy, sandy refuse layer, zone B. Almost 1 m thick in the center of the site, it averaged about 30 to 40 cm thick and pinched out at the edges of the site. Since Late Archaic materials occurred in its upper levels, we can date its deposition as roughly between about 6,000 years ago and the time of Christ.

Various occupations, representing different periods, were found at different depths within zone B. Seemingly the earliest was the rock floor layer, feature 6, found at the juncture of zones B and C in the test square S11E31. This feature seems roughly contemporaneous with the burned floor, feature 4 or zone B3, in square S11E24. A few artifacts recovered from the latter square hint that these features may represent some Middle Archaic occupations occurring between 2300 and 830 B.C. Extending down from a floor in the lower middle part of zone B was the roasting pit, feature 2 of zone B2, which roughly could be contemporaneous with feature 3, the fire pit in square N10E24. A Todsen projectile point in N1E32 suggests this zone B depositional period began in the Keystone phase, roughly from 4000 to 2600 B.C. Right at the top of zone B in this trench was a possible floor, zone B1 (feature 7), the few artifacts of which suggest it was of Late Archaic times (Hueco phase) between 900 B.C. and A.D. 230.

The top stratum, zone A, composed of humus and dune sands, contained Mesilla sherds as well as modern cartridges, and could have been deposited between the time of Christ and yesterday. So far no real occupational levels have been found in this stratum.

Thus, at the end of the 1988 season, the stratigraphy of North Mesa was defined roughly as follows:

Zone A	–	modern and Mesilla phase
Zone B1	–	Hueco phase
Zone B2 (feature 2)	–	maybe Fresnal or Hueco phase
Zone B3 (feature 4)	–	maybe Keystone phase
Zone C1 (feature 1)	–	Gardner Springs complex
Zone C	–	?
Zone D	–	possibly Clovis
Zone E	–	?

Most of this good stratigraphy was in a relatively small area, between 0E19, N10E24, S11E24, 0E32, and S10E23. This area defined where we were to work in 1989.

1989 Season

The 1989 season began in late January with some of the old veterans back: myself as director, Bob Smith as crew chief, Peggy Wilner as lab chief, Drew King as surveyor and photographer, and Jane Libby as editor. Added to this base group were three sponsored students–Peter Dawson from the University of Toronto, Brenda L. Smith from the University of Saskatchewan, and Geoffrey Cunnar from the University of Colorado. This base crew was aided and assisted by a whole series of Friends of the Foundation who came for two-week stints. These included Fuzzy Downs, Bill and Cheryl Hudson, Chris Virgil, Mimi and David Horner, Libby Cook, Bonnie and Emmett Tainter, Bruno Marino, Don Chrisman, and Paul Lopatin. Dave Hill also was part of our team–both digging and analyzing our ceramics.

Occasional visitors who joined in the digging included Phil Secor, Glenna Dean, Dan Wolfman, David and Melli Kirkpatrick, Pat Beckett, and an occasional student from NMSU. With the help of all these people we moved a lot of dirt. While the excavation was going on, our well-equipped laboratory, under Peggy Wilner and myself, analyzed all

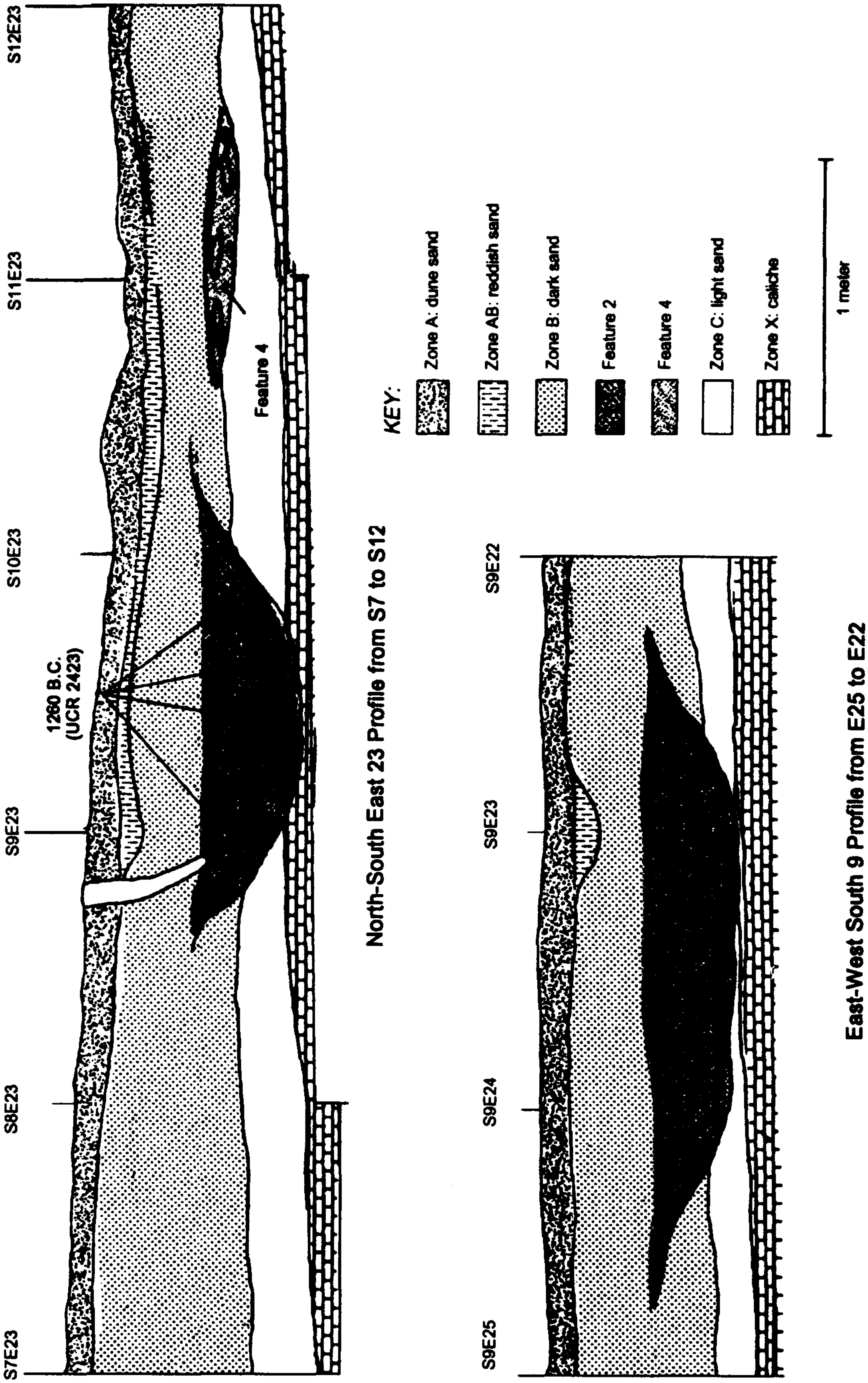


Figure II-5. North Mesa: South Trench with Features 2 and 4

all the Tornillo and Todsen data, drew floor plots that located all artifacts and ecofacts for each zone, and kept abreast of the materials coming in from North Mesa.

In terms of the actual digging, we expanded the areas tested in 1988 that we had found to be productive in the east-central part of our site. Not only did we obtain many more artifacts, but most of these came from features, including many new ones, which further subdivided our stratigraphic sequence.

Central Trench. One big area to be expanded–both downward, northward, and westward (see Figure II-6)–was the central trench from S1E21 to S1E24 and 0E23 and 0E24. Put in charge of this was Dawson. Actually dug were S1E20, 0E20, N1E20, N2E20, 0E21, N1E21, N3E21, 0E22, N1E22, N2E22, N3E22, N1E23, N2E23, N1E24, and W2E24. The main concentration of artifacts was found below zone B, although there were a few from zone A (of dune sand origin) and at the junction of zones A and B (zone AB). From the strata we divided zone B arbitrarily because of the stratigraphy of the other trenches into upper B, middle B, and lower B–all told, the central trench had five zones and a huge pit, feature 10, which came down from zone B.

The real artifacts came from zone C and below. The thin stratum (10 to 20 cm thick) called upper C, which lay above feature 1 in zone C1, produced some artifacts seemingly of the Keystone phase, and feature 11 in it dated at 2560 B.C. The largest number of artifacts, however, came from zone C1, feature 1, which was a pavement of fire-cracked small pebbles or boulders covering an area of about 6 m northeast-southwest and 4 to 5 m northwest-southeast. The artifacts therein, about 70, were of Gardner Springs type, roughly of the period from 6000 to 4500 B.C. Below zone C1 was another light brown zone, called lower zone C (about 40 to 60 cm thick), which had only occasional artifacts, but a definite Clovis point fragment, a flute fragment, and small snub-nosed endscrapers, as well as a few other not-very-diagnostic tools. Exactly what culture phase this represented could not be ascertained, but it could pertain to Angostura and/or Folsom since it overlay zone D, a probable Clovis component.

Zone D, a thin, dark brown stratum, covered the central portion of the excavation area and was less than 5 cm thick and usually about 1.6 m below the surface. The Clovis point, snub-nosed end scraper, snub-nosed end scraper with lateral spur, blades, and other tools recovered suggest there is a Clovis occupational floor, and the fossil bone on it should give a date to confirm or deny this estimate.

Underneath zone D was another brown sand zone (zone E) that looked exactly like zone C, and where zone D did not separate the two, zone E was indistinguishable from zone C even though soil analysis revealed zone E was fluvial and zone C eolian. Zone E contained a few artifacts and small fragments of fossil bone, but except for a unifacial point, pebble sidescrapers, choppers, and a crude blade, none was very diagnostic. At present, it is difficult to tell if this is a Clovis or a pre-Clovis component, and we hope dates on its bone may solve this dilemma. It might be added that zone E never was more than 30 cm thick except at N1E22, where a huge animal burrow disturbed it and went to a depth of 2.5 m and overlay the caliche (zone X) that overlay the oligocene river pebbles that are hundreds of thousands of years old. This stratigraphic column expanded the one of 1988, into which the new features of the other trench areas dug in 1989 could be plugged.

East Trench. The east trench–often called Geoff's Trench–was only 1 m east of our central-east excavation just described. It was composed of squares S1E26, 0E26, N1E26, N2E26, S1E27, 0E27, N1E27, S1E28, S1E29, S1E30, S1E31, S1E32, and S1E33 (the last three having been dug in 1988). Again zones A and AB, only about 10 to 30 cm thick, capped the area, had few artifacts in them, and overlay an upper zone B, about 20 to 30 cm thick. This zone in turn overlay a charcoal floor (feature 7), about 5 cm thick in squares S1E26, 0E26, N1E26, S1E27, 0E27, and N1E27. Lying on this floor were a Hueco point, a small disk plano-convex scraper, two boulder metates, two slab metates, a paint palette, and three two-handed manos, which indicate an activity area (grinding corn) of the Hueco period. The radiocarbon date of A.D. 40 confirms this assignment (see Figure II-7).

Below feature 7 was a middle zone B horizon, and in lower B we found a Todsen point and tools of Keystone times. This zone was only about 1 m thick, like the north-central trench, but the zone C portion was much thinner, a 10-cm layer–called upper C–and a lower zone C of brown sand that was mixed with caliche and overlay zone X. This lower portion of zone C was only 20 cm thick and 1.20 to 1.40 m below the surface; it could be contemporaneous not only with lower C to the west, but also to zones D and E. A Clovis point fragment recovered from it tends to confirm this conclusion. Our second trench thus expanded the stratigraphy of the first 1989 trench.

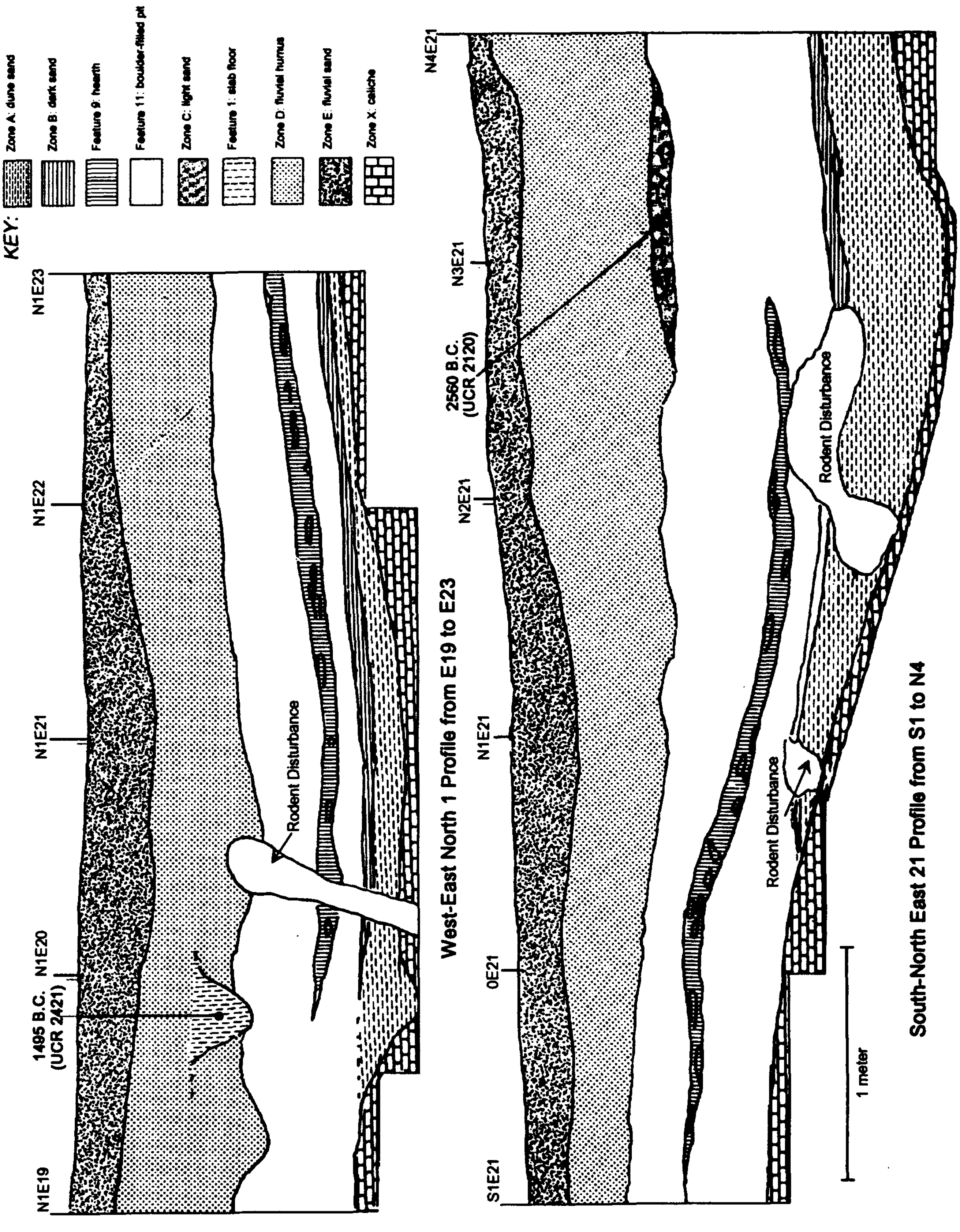


Figure II-6. North Mesa: Central Trench with Features 1, 9, and 11

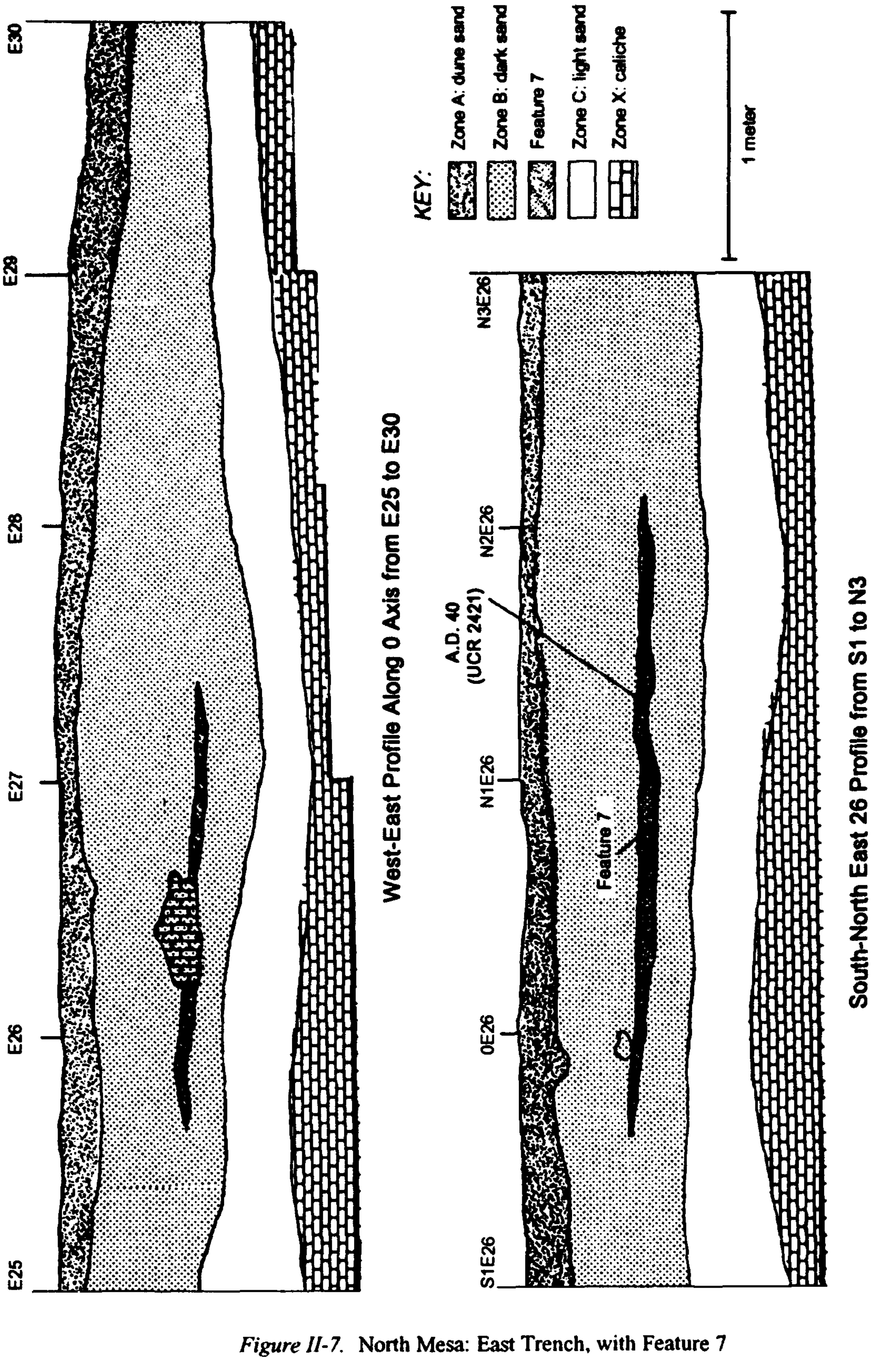


Figure II-7. North Mesa: East Trench, with Feature 7

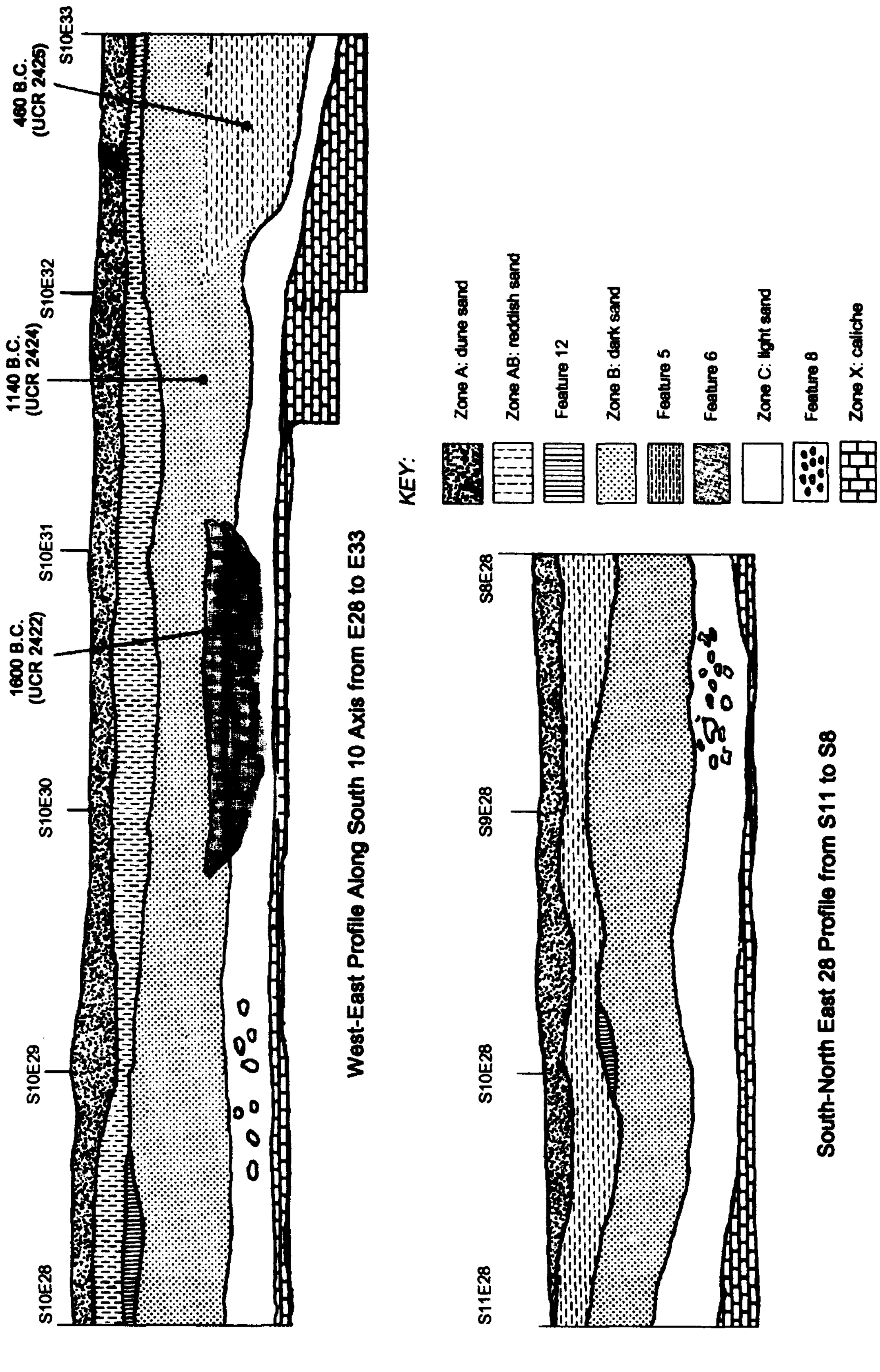


Figure II-8. North Mesa: Southeast Trench with Features 5, 6, 8, and 12

South Trench. The south trench, or Drew's Trench, had hinted at complicated stratigraphy in 1988 around feature 2 in zone B and various subdivisions of zone B, such as B1, B2, and B3, as well as feature 4 and the first two Clovis points. We expanded our 1989 trench in this southwest-central region and dug squares S11E24, S11E23, S10E25, S9E25, S8E24, S6E24, S5E24, S4E24, S4E23, S3E24, and S2E24, but met with limited success. Feature 2, radiocarbon dated 1250 B.C., was a basin-shaped pit 30 to 40 cm deep and 3 m long northeast by southwest and only about 2 m northwest by southeast. It was filled with charcoal and burned earth covered by hundreds of fire-cracked cobbles. A few pieces of burned cactus leaves lay on the rock as did a couple of scrapers and a broken Chiricahua point, indicating the pit was used in Fresnal times–3000 (or 2600) B.C. to 900 B.C.

Pit 4 in the south end of the trench, at the juncture of zones B and C, was so poor in artifacts we abandoned it and concentrated on excavating a dog burial in the top of zone B, Hueco phase, in square S5E24. This trench also added to the stratigraphy of zone C.

North Trench. Equally unproductive was the north trench, consisting of squares N6E23, N7E22, N7E23, N7E24, N8E23, N8E24, and N9E23. Here, extending down from the middle or upper part of zone B, was a charcoal floor, called feature 3. We originally thought this might be the floor of a pithouse, but excavation did not reveal any pithouse sides and seemed to suggest the charcoal-covered area perhaps was the root system of a burned mesquite tree. The feature contained few artifacts other than a couple of Hueco types. Zone C, which lay under it, was quite deep (1.5 m), but contained only chips.

Southeast Trench. The final area we had revealed in 1988, in sample 1-m square S11E32, was a pavement of rocks (feature 5) at the middle of zone B. Expansion of this southeast trench, also called Jane's Trench, into S10E32, S11E33, S11E34, S10E33, and S10E34, uncovered a small area of charcoal covered by cobbles extending down about 20 cm into zone C (see Figure II-8). Its few artifacts were of the Hueco type and the pit was only about 2 m east-west by 1 m north-south. This feature contrasted with another–feature 6–just to the east of it in squares S11E31, S11E30, S11E29, S10E31, S10E30, and S10E29. Here a pit about 30 to 40 cm deep, with almost vertical sides, and 3 by 2 m east-west had been dug from the bottom of zone B into zone C. Next the pit had been lined with a series of rock slabs that included many fragments of mullers and milling stones of Fresnal type, and a huge fire was built in it of small sticks and twigs to roast cactus leaves, which were placed over the hot coals. The roasting pit was radiocarbon dated, from the artifacts found in it, at 1600 B.C. A number of Fresnal artifacts, including a Chiricahua point, were in zone B (feature 12) above it, and it overlay another rock floor, feature 8, in zone C below it that had a Bajada point and other Gardner Springs artifacts (6000-4500 B.C.). Most of the feature 8 pavement of slab, only about 1 m in circumference, was to the west of feature 6 in squares S10E29, S11E28, S10E28, S9E29, and S10E27. The southeast trench thus revealed further stratigraphic units for the site.

Summary

We received dates for many of these stratigraphic units by both radiocarbon determinations as well as archaeomagnetism, but even without these dates we have a fine relative stratigraphic sequence, as follows:

Zone A	– dune sand: modern and Mesilla phase
Zone AB	– brown sand: Mesilla phase, A.D. 250-900
Feature 12	– charcoal floor: Hueco phase, A.D. 0-250
Feature 7	– charcoal floor: Hueco phase, A.D. 40
Upper B	– dark sand: Hueco phase, A.D. 0-250
Features 3 and 10	– tree burn in zone B: Hueco phase, 400 B.C.- A.D. 0
Feature 5	– pit of fire-cracked cobbles: Hueco phase, 460 B.C.
Middle B	– dark sand: Fresnal phase, 1140 B.C.
Feature 2	– pit of fire-cracked cobbles: Fresnal phase, 1250 B.C.
Feature 9	– hearth: Fresnal phase, 1495 B.C.

Feature 6	–	slab-lined pit: Fresnal phase, 1600 B.C.
Feature 11	–	pebble hearth: Keystone phase, 2560 B.C.
Feature 4	–	pit of fire-cracked cobbles: Keystone phase, 3100-2900 B.C.
Lower B	–	dark sand: Keystone phase
Feature 8	–	rock pavement: Gardner Springs phase, 6000-4500 B.C.
Upper C	–	brown sand: Gardner Springs phase, 6000-4500 B.C.
Zone C1, Feature 1	–	rock pavement: Gardner Springs phase, 6000-4500 B.C.
Lower C	–	brown sand: ?
Zone D	–	floor of dark brown sand: Clovis, 10,000-9000 B.C.
Zone E	–	brown sand: pre-Clovis, more than 12,000 B.C.
Zone X	–	caliche and river pebbles; Oligocene

All in all, the excavation of North Mesa gave us 21 or 22 stratigraphic units representing seven or eight culture phases starting before 12,000 years ago. Many of these occupations had slightly different functions, and what limited seasonal materials we have suggest they occurred in the summer months. Contextual analysis will be made of these units in a later chapter.

A number of other stratified sites with relevant Archaic materials have been dug in the Las Cruces region, and some of Carmichael's survey in the Tularosa Basin on Fort Bliss identified Archaic sites that may be seriated in chronological order. Since we used and analyzed the materials from these sites in building our chronology, let me say a word about each, which we hope will not infringe on the descriptions or analyses done by the various excavators.

Organ Mountain Sites

Situated with Tornillo Rockshelter, in the same alluvial slope ecozone that has plants that reach fruition in the late summer-early fall, were a number of other rockshelters with relatively shallow refuse deposits and limited natural stratigraphy. From 1983 through 1986 Upham, with his archaeological class from NMSU, tested 10 of these sites, including Tornillo. Although the sites were dug in arbitrary levels (usually 20 cm), the excavation was done carefully (MacNeish 1978), backfill was fine-screened, and meticulous notes were taken.

Six of these rockshelters–Peña Blanca, Rincon, Roller Skate, Sonrisa, Knee Pad, and Thorn (see Figure II-9) produced artifacts Upham allowed us to analyze. Four of the shelters were dated by Chris Stevenson using obsidian hydration, while one–Peña Blanca–gave four radiocarbon determinations. Since these materials tend to confirm our basic culture stratigraphy and sequence of phases and to strengthen their dates, let me briefly comment on each one and its significance.

Peña Blanca. One of the early sites excavated, Peña Blanca (NMSU1423) is situated well up in a small dome to the west of the other shelters. Facing north, it is about 20 m long and has a maximum overhang of about 4 to 5 m (Johnson and Upham 1987). The shelter has a maximum depth of about 1.5 m, and eight or nine levels were excavated. The upper four levels contained sherds of the El Paso and Mesilla phases as well as small arrow points mixed in with Archaic points. Radiocarbon determinations on charcoal from level 2 were A.D. 1420 ±60 (Beta 6859) and A.D. 1330 ±50 (Beta 6858); while obsidian dated at A.D. 1084 (NMSU85-80). Charcoal from level 3 dated at A.D. 1160 ±60 (Beta 6861) and A.D. 1150 ±70 (Beta 6860), while associated obsidian was dated at A.D. 783 (NMSU85-85).

The first evidence of the preceramic seems to begin in level 5 (although it had an occasional sherd); it contained an obsidian Hatch point dated at A.D. 88 (NMSU85-86) and a chip from mixed levels dated at 1970 B.C. (NMSU85-78). Two domed scraper planes from level 6 and a Jay-like point from level 8 attest to a definite preceramic occupation.

Rincon. On the other side of the Peña Blanca dome, at its base and facing south, is Rincon shelter (NMSU1524). It is shallow–only about 2 or 3 cm deep–and 1-16 m long. Much of its refuse was fire-cracked rock that extended out onto a platform in front of the shelter. Seven arbitrary levels were dug, to a depth of more than 1 m. The top four 5

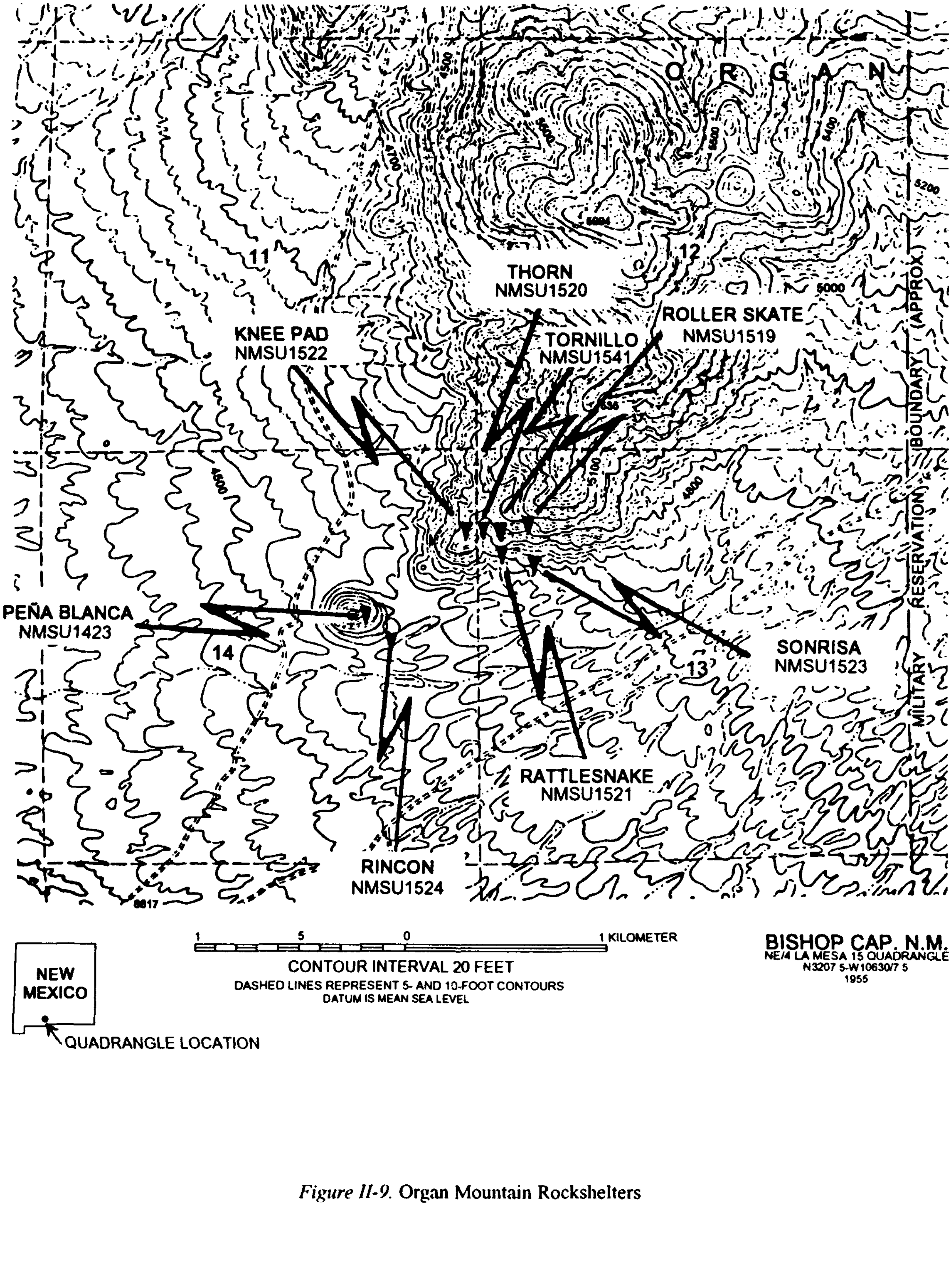


Figure II-9. Organ Mountain Rockshelters

levels contained arrow points and sherds; level 2 dated at A.D. 1135 (NMSU85-90), while an obsidian chip from level 3 gave a reading of A.D. 1118 (NMSU85-91). Since some of the sherds were of the El Paso phase, these dates seem about right. The obsidian date of A.D. 994 (NMSU85-99) for level 4, which had mainly Mesilla sherds, tends to confirm the stratigraphy, even though a Bajada-like point came from that level. An obsidian Hueco point in level 5 gave a date of A.D. 244 (NMSU85-93), apparently the first evidence of the preceramic. In level 7, an obsidian Todsen point gave a date of 3057 B.C. (NMSU85-97), which may represent the earliest preceramic occupation. However, few other lithic artifacts existed to confirm such a conclusion.

Sonrisa. The easternmost area excavated, Sonrisa (NMSU1523), is well up in the cliffs. The shelter is very long–50 m–with an overhang of 4 to 8 m, and faces south. The four 2-m test squares dug in it revealed the refuse was very shallow (less than 50 cm). Although there were few artifacts, most of the occupation seems to have been preceramic. Hueco points in level 2 dated at A.D. 260 (NMSU86-247) and A.D. 305 (NMSU86-248), while one from level 3 dated at 182 B.C. (NMSU86-251). An obsidian chip in level 6 dated at 2523 B.C. (NMSU86-245), but no other diagnostic artifacts were associated with it.

Roller Skate. High up in the cliffs above Sonrisa is Roller Skate (NMSU1519). It faces south and is more than 20 m long; its overhang of more than 8 m meant preservation of plant remains and other perishables was excellent. Since deposits were shallow with no discernible natural stratigraphy, the site was dug in arbitrary levels. The top four levels contained sherds of the El Paso and Mesilla phases, arrow points, and corncobs of the Chapalote, Proto-Maiz de Ocho, Maiz de Ocho, Pima-Papago, and Pueblo races. The early races–mainly Chapalote, Proto-Maiz de Ocho, and Maiz de Ocho–occurred below the later races, and a Hueco and/or San Pedro obsidian point in level 6 gave a date of 138 B.C. (NM85-86). A Todsen point in level 7 gave a date of 3095 B.C. (NM85-88), but the other artifacts and corn of the Hueco phase suggest this point was churned up from an earlier, but undiscernible, Keystone occupation.

Knee Pad and Thorn. The other two Organ Mountain shelters–Knee Pad (NMSU1522) and Thorn (NMSU1520)–also are high up in the slopes. They face south and are smaller than the other rockshelters. Both had shallow deposits and few artifacts, and are undated. In terms of early corn races, Knee Pad seems to be preceramic, but it had only a couple of bifacial fragments to attest to that fact. Thorn, however, did have a Hueco point in its limited levels, suggesting preceramic occupations.

Summary

Although the Organ Mountain rockshelters did not have a large sample of artifacts and were dug in arbitrary levels, they did tend to confirm our sequence from the better-stratified sites previously discussed. The Bajada-like point–albeit from a level with pottery–in Rincon and the Jay-like point in level 8 of Peña Blanca suggest some sort of foray into these shelters in Gardner Springs times, 6000-4500 B.C. Possible visits to these shelters during the Keystone phase (4500-2500 B.C.) are suggested by the obsidian dates of 3057 B.C. on a Todsen point in level 7 of Rincon, the date of 3095 B.C. on a Todsen point in Roller Skate, the date of 2523 B.C. in level 6 of Sonrisa, and by artifacts in levels 7, 8, and 9 in that same shelter. Late wet-season visits to the shelter during the Fresnal phase, 2600-900 B.C., are indicated by the occupations in Tornillo as well as by the types of corn found in all levels (1-5) in Knee Pad. Better artifacts and dating evidence of late wet-season forays or task force visits in Hueco times, 900 B.C. to A.D. 350, occur in a number of shelters: levels 5 and 6 of Peña Blanca and Rincon; levels 2-6 in Sonrisa; levels 4-9 of Roller Skate; and levels 3-5 of Thorn. Dates of Mesilla phase occupation are suggested in levels 3 and 4 of Peña Blanca and level 4 of Rincon. Later forays during the Doña Ana or El Paso phases, A.D. 900-1350, seem to be represented in the upper levels of most shelters. Table II-1 suggests the sequence of occupation by phase for the shelters tested by Upham and his classes from 1983 to 1986.

Table II-1. Correlation and Dates of Some Organ Mountain Sites

PHASE	PEÑA BLANCA LEVEL	RINCON LEVEL	SONRISA LEVEL	ROLLER SKATE LEVEL	KNEEPAD LEVEL	THORN LEVEL	OBSIDIAN HYDRATION ESTIMATE	RADIOCARBON DETERMINATION
El Paso and/or Doña Ana	1							A.D. 1420
	2						A.D. 1084	A.D. 1330
		1						
		2					A.D. 1135	
		3					A.D. 1118	
						1		
				1			A.D. 1084	
Doña Ana and/or Mesilla	3						A.D. 783	
	4							A.D. 1160
		4					A.D. 994	A.D. 1150
				2		2		
			1	3				
	5-6						A.D. 88	
Hueco							A.D. 308	
			2				A.D. 260	
		5					A.D. 244	
		6						
						3		
						4		
				4				
				5				
				6			138 B.C.	
			3				182 B.C.	
					1			
			4					
			5					
				7, 8, 9				
Fresnal					2			
					3			
					4			
					5			
					6			
Keystone			6 point				2523 B.C.	
		7 point					3057 B.C.	
				point			3095 B.C.	
Gardner Springs								
	7							
	8							

Fresnal Shelter

From the standpoint of early agriculture and the Archaic in the Jornada region of the Southwest, one of the most important excavations was that of Fresnal Cave, which was undertaken by Mark Wimberly and Peter Eidenbach from 1969 through 1972 (Wimberly and Eidenbach 1972). Initially the research was under the sponsorship of Irwin-Williams, who early recognized the materials represented a third Archaic tradition–the Eastern (which we now call the Chihuahua Tradition)–which was significantly different from the Cochise Tradition or the Oshara (Irwin-Williams 1979).

The Foundation was most fortunate to begin its research in this region when Carmichael was studying the materials from Fresnal and getting some of those materials dated by the Illinois State Geological Survey (Carmichael and Gerald 1986). Not only did he explain the significance of the site generously, but one Easter morning he took me there and showed me the stratigraphy in the still-open trenches. Combined with his fine paper presented at the American Archaeological Conference at Urbana, Illinois, in 1981, this field illustration explained the cultural sequence and provided dates on the domesticated plant remains. As a further aid to analysis, Carmichael gave me photographs of every excavated projectile point with the provenience indicated (see Chapter IV on typology).

Fresnal Shelter is located on the western flanks of the Sacramento Mountains, about 10 km (6 miles) northeast from Alamogordo, New Mexico, within the Lincoln National Forest (see Figure II-10). The shelter is at an elevation of about 1,920 m (6,300 feet), and local vegetation is in the pinyon-juniper zone that yields abundant foods in the late summer-fall seasons. The slopes below the cave, moreover, have considerable diversity. Those facing north are dominated by pinyon, juniper, and agave, while the southern exposures have more mesquite, sotol, broad-leaf yucca, and many varieties of cacti. Below the cave is a stream that flows out of a spring, resulting in more riparian vegetation and patches of grasses that yield edible seeds in the spring.

Fresnal Shelter lies at the base of an overhanging cliff, about 30 m high, of Pennsylvanian limestone. The main shelter faces south and is about 30 m long, east-west, with a maximum depth of 10 m. The maximum depth of deposits was about 2 m. For excavation, the shelter was staked out in a 1-m grid system. In the first season refuse was stripped off in arbitrary levels, 5 and 10 cm, but in later seasons natural strata were exhumed. Much of the material was screened and floated and meticulous notes were taken.

Analysis of the faunal remains, undertaken by Wimberly and Eidenbach (1972) and Cathy Cameron (1973) seemed to indicate a late summer-fall occupation. Dr. Vorsila Bohrer (1972) has an ongoing study of the floral remains, and Carmichael commented on the domesticated plants in his 1981 speech at Minneapolis, Minnesota. He also assisted us with our analyses of the projectile points. There seem to be two complexes of types. From the upper levels (probably zones A-C) came six San Pedro Small, four Hueco, two En Medio, two San Pedro Large, one Hatch, and one Nogales. Points from the lower levels (perhaps zones C1 through F) included seven Fresnal, six La Cueva, one Augustin, one Shumla, one Chiricahua, one Maljamar, and one San Jose. A Bajada-like point might have come from an even earlier occupation (perhaps zone H, with dates of 5951 and 6119 B.C.). The points recovered thus seem to provide good evidence of a culture sequence.

Included in Carmichael's articles were copies of some of the main profiles (see Figure II-11) and their radiocarbon dates. We have given the Fresnal zones the following designations:

Zone A	Manure.
Zone B	Loose and disturbed vegetal material that blended into zone B1.
Zone B1	Gray-brown soil with much vegetal material, including corn, bean, and squash remains, as well as a Hueco projectile point.
Zone C	Dark gray in color, with remains of much grass, as well as corn, beans, and squash, and more Hueco points. Zone C has two carbon 14 dates: 925 ±116 B.C. (ISGS897) and 1010 ±70 B.C. (ISGS969).
Zone C1	Similar to zone C–dark gray in color, but with much charcoal and different projectile points (Fresnal types), seemingly with corn. The zone has one date of 1360 ±146 B.C. (ISGS933).

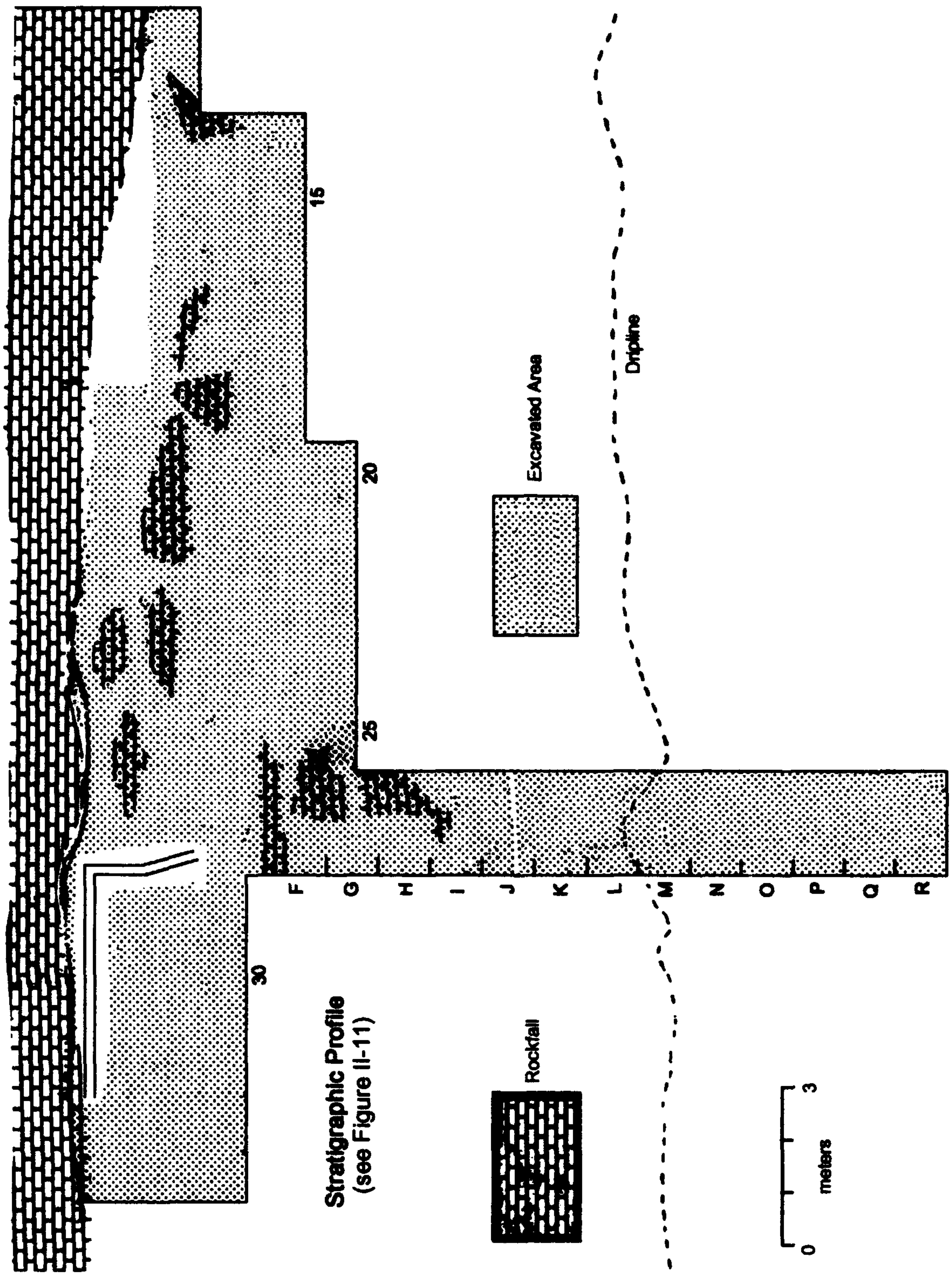


Figure II-10. Fresnal Shelter: Plan of Excavation Units, 1969-1972

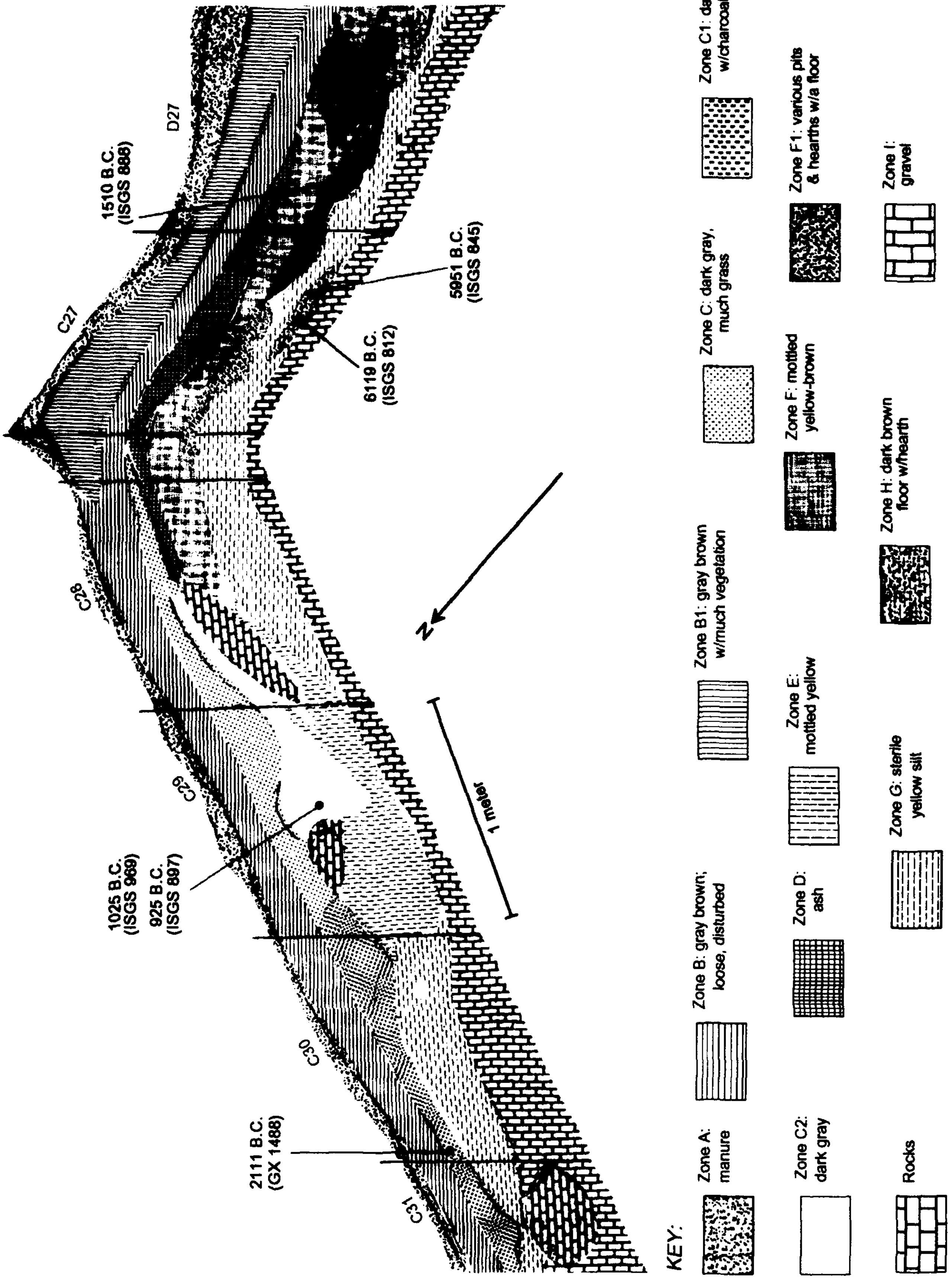


Figure II-11. Stratigraphic Profile of Fresnal Shelter

Zone C2	Dark gray pit, like zone C1, with similar materials.
Zone D	A thin ash layer, down from which was dug pit 1, containing 11 maize kernels, 220 beans, 2 juniper berries, and Fresnal points. The beans included common black beans and violet striped beans, both Southwest varieties of *Phaseolus vulgaris* (Kaplan 1956).
Zone E	A mottled yellow pitlike stratum with few remains.
Zone F	Mottled yellow brown.
Zone F1	Mottled ash with pits 2, 3, and 4, containing corn, amaranth, and more Fresnal-type points. Charcoal next to a corn stalk dated at 1510 ±146 B.C. (ISGS888).
Zone G	A relatively thick (56-70 cm) sterile yellow silt layer that seemingly was without artifacts. A date of 2111 ±153 B.C. (GX1488) on charcoal may come from this zone or the bottom of the overlying zone F.
Zone H	A dark brown, humuslike feature with charcoal that gave dates of 6119 ±126 B.C. (ISGS812) and 5951 ±125 B.C. (ISGS845). Whether the Bajada-like point pertains to this feature is problematic (analysis of the associated artifacts remains to be done).
Zone I	Sterile gravel that capped the limestone floor of the cave.

Summary

Fresnal Shelter had excellent stratigraphy and its dated domesticated plant remains are of key importance in understanding the beginning of agriculture in the Southwest because they represent some of our earliest dates for domesticated plant remains in the region. Also, the dates of 6119 and 5951 B.C. on Archaic materials in zone H are some of our earliest dates for that stage in the Jornada region. The dates of 1360 and 1510 B.C. for zones C1 and F1, respectively, help date the Fresnal phase projectile points as well as early corn and amaranth. Dates of 1010 B.C. and 925 B.C. in zone C seem to date the beginning of the Hueco phase occupations of the site and indicate when common beans joined the earlier domesticates. Hopefully one of these days these important materials from Fresnal will be analyzed fully and the results published, for they are a major supplement to the other Archaic materials we have been reporting in this chapter.

La Cueva

While this series of caves just east of Las Cruces has been known for many years–Don Lehmer (1948) initiated excavation in 1946–my description of its stratigraphy and analysis of its Archaic chronology is based on trenches dug by Thomas O'Laughlin and his students from the University of Texas at El Paso (UTEP) in the summer of 1973.

La Cueva is about 10 miles east of Las Cruces at the foot of the eastern slopes of the Organ Mountains, with an elevation of about 5,436 feet above sea level. It is right above (60 m) a small stream that flows down from Dripping Springs, which has a gallery forest-type of vegetation. The cave itself is in the lower alluvial slope ecozone with sumac, mesquite, saltbush, creosote, prickly pear, yucca, saltbush, whitethorn acacia, sotol, various cacti, grasses, and scrub growth. These plants reach their maximum fruition from April through July, although some foods would be available well into October. Since the cave faces south and has a spring, people could come to it year round, even in the winter.

La Cueva is about 20 m across at its mouth and extends back about 12 to 14 m with a low (3-m) fire-blackened ceiling and an extensive refuse-filled talus in front of it above the steep bank leading to the stream below. When Lehmer put a trench in it in the 1940s, he mainly found ceramic materials, but the bottom of his 2-m-deep trench may have struck Archaic remains. Since that initial sounding, the cave had been looted extensively, but in 1960 O'Laughlin (1968) put in four test pits. Then in 1973 he, with his field class, put in three more soundings (Williams and Martin 1980). One of these, a 4- by 2-m trench in the talus, reached a maximum depth of more than 4.6 m below datum and the lower 2.4 m of it seemed to be in undisturbed refuse (see Figure II-12). The other trenches were 1- by 1-m test excavations.

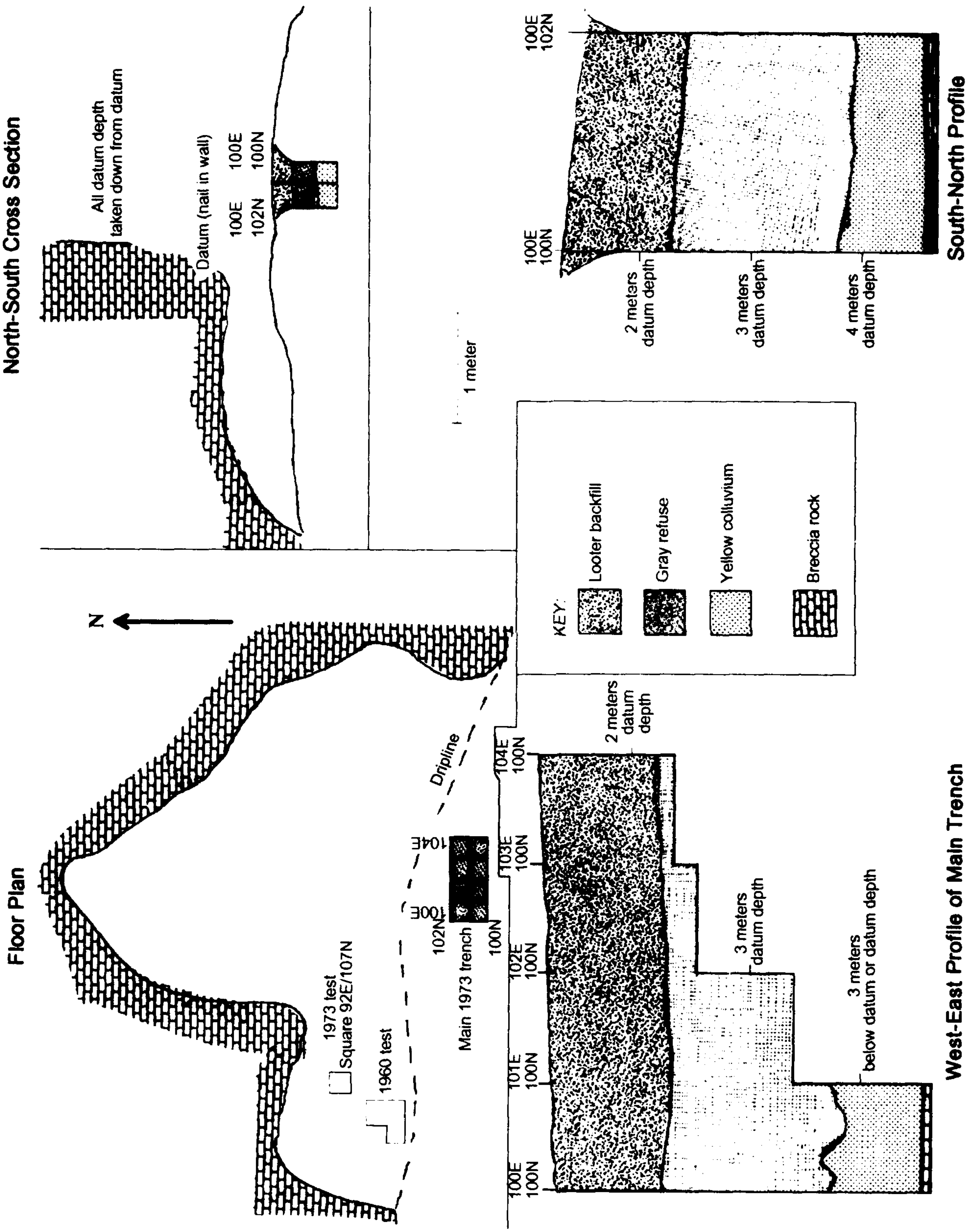


Figure II-12. Map and Stratigraphic Profiles of La Cueva

La Cueva had few discernible strata in it and was dug in 10-cm arbitrary levels. In 1986 we borrowed the La Cueva projectile points from O'Laughlin for study. Since the materials from the upper 2.2 to 3.8 m contained sherds and snub arrow points and were not Archaic, we concentrated our study on the materials from 3.2 to 4.6 m, equalling 14 arbitrary levels. As at Fresnal, there seemed to be two sequential clusters of types, representing the Fresnal and Hueco phases. From levels 3.2 to 4.6 came two La Cueva, two Abasolo, two Chiricahua, two Todsen, one Augustin, two San Jose, and one Armijo. In levels 2.2 to 3.1 the dominant types were Hueco, Hatch, San Pedro Small and Large, and Shumla.

These projectile types further confirm the stratigraphy of our other sites: Fresnal types (2600-900 B.C.) appear stratigraphically under Hueco ones (900 B.C.-A.D. 250), which underlie levels with Mesilla and El Paso sherds.

Archaeological Survey in the Southern Tularosa Basin

This section is about neither stratigraphy nor excavated sites, but Archaic sites found in the intensive survey of 991 sq. km in Maneuver Area 3-8, which was undertaken by Carmichael for the Directorate of Engineering and Housing of the United States Army Air Defense Artillery Corps at Fort Bliss, Texas, under the direction of Dr. Glen DeGarmo in 1980 and 1981 (see Figure II-13). This survey (Carmichael and Gerald 1986) is germane to our discussion of the Archaic chronology, for a seriation analysis of materials (mainly 219 projectile points) from 174 sites tends to confirm our Archaic sequence found in the previously described sections on archaeological excavation. It also adds significant new data about the Archaic in the realm of demography and settlement patterns as well as enhances our sample of Archaic types (or artifactual time markers).

The analysis of these materials began in AFAR's first season, 1985, when I was groping to determine the Archaic sequence in the Jornada-Mogollon region. At that time I had four sources of materials. One was Beckett's master thesis (1973) that had classified the Archaic points into 15 types he considered to be Cochise, basically. The second was the very few possible Archaic points Upham had uncovered in the lower nonceramic levels of his excavations in the Organ Mountains. A third source was the few Archaic points I had dug up in the Rio Puerco area when excavating Irwin-Williams' stratified Cuervo site in 1984. Finally, I had a huge manuscript by Carmichael on his Tularosa survey that illustrated a series of types he thought showed the sequence of the Archaic. These types were Jay, Bajada, and Bat Cave for Early Archaic; Amargosa, Chiricahua, Pelona, Augustin, San Jose, Shumla, Datil, Flacco, and Langley for Middle Archaic; and San Pedro, Armijo, Williams, Marcos, Ellis, Bat Cave #8, Endor, Edgewood, Marshall, and Figueroa for Late Archaic. It soon became apparent to me that Beckett, Irwin-Williams, and Carmichael were coding the same points (or group of points) by different type names and that the types described for other areas (namely Texas and Bat Cave) did not apply directly to the Jornada region. In fact, it seemed Irwin-Williams was correct, and our Jornada-Hueco region had a different projectile point and cultural tradition, which she called Eastern, in contrast to the Cochise and Oshara traditions. When I discussed the problems of Archaic point typology with Carmichael, he showed me the actual points (more than 300) in the Fort Bliss collection. He also encouraged me to begin a projectile point seriation study of Tularosa Archaic survey specimens from his various sites.

This analysis did not take place until the following season (1986), when it was done in conjunction with the study of our sequential groups of projectile points from the stratified levels of Todsen Cave (LA5531). It soon became apparent the Early Archaic sites mainly had Jay, Bajada, and Abasolo-like points, as Carmichael had speculated. Middle Archaic sites, however, had two different clusters of types. The earlier group had Bat Cave, Amargosa, Pelona (Beckett's type 1), Almagre-Gypsum, and a new side-notched type with a squarish base–originally called type 5 by Beckett and including some Carmichael called Chiricahua–which we rechristened Todsen, after the cave we were digging where this type was produced in some numbers. The later group of Middle Archaic sites seemed to produce San Jose; Augustin (Beckett's type 2); Chiricahua (Beckett's type 3); a new, similar side-notched type with a convex base we called La Cueva; Armijo points (Beckett's type 8); and a new type called Fresnal that Carmichael had called Palmillas and/or Edgewood-like or straight stemmed.

Even more numerous than this late Middle Archaic group of sites were sites of the Late Archaic, which had still another cluster of point types. These included En Medio, Shumla, San Pedro Large (Beckett's type 6), and San Pedro Small, which Carmichael had recognized early, but our new sequential dates reclassified many he called San Pedro

Large or Marshall into a new type called Hueco (Beckett's type 9), and many of his small San Pedro points were changed into the new Hatch designation (Beckett's types 10 and 11).

Further, our study in 1986 through 1989 of all lithics from all stratified zones of the Todsen (LA5531) and North Mesa (LA5529) sites indicated each of these four clusters of projectile point types was associated with four unique clusters of other kinds of lithic types, burial types, subsistence factors, and other culture features that allowed us to classify the Archaic into four cultural phases–Gardner Springs (6000-4500 B.C.), Keystone (4500-2500 B.C.), Fresnal (2500-900 B.C.), and Hueco (900 B.C. to A.D. 300). Now we were ready to re-examine the 818 sites of the Tularosa survey (see Carmichael and Gerald 1986, Table 10), specifically the 243 sites classified as Archaic. Of these, only 174 had projectile points (216) we could identify readily as to type so we could classify a site as to its phase (see Carmichael and Gerald 1986, Appendix C).

Gardner Springs. The earliest phase, Gardner Springs, was represented by 14 sites. On five of them–Fort Bliss 701, 3611, 504, 5561, and 465–were Jay points; one (FB4884) had a Jay point and two Bajada points, while seven–FB3437, 5505, 1681, 543, 1979, 2985, and 3981–had Bajadas, and FB1754 had a Jay point and an Amargosa point diagnostic of the following Keystone phase. All sites were small, had five grinding stones and an occasional end scraper, and were very different from the following group, classified as the Keystone phase.

Keystone. This phase seemed to be represented by at least 23 sites, although nine of them are very small and have few data on settlement or seasonal patterns. Eight of these sites have Bat Cave points (FB428, 5239, 521, 1624, 1978, 540, 541, and 58), while sites 1608 and 70 had a Bat Cave point as well as an Amargosa-Pinto point. Sites with Amargosa-Pinto points included FB2957, 3551, 401, 1589, 1543, and 466. Site FB1601 had an Amargosa point, a Gypsum-Almagre point, and a Pelona point. Sites with Pelona points included FB52 and 3006. Site FB1566 had a Pelona point and a Todsen point, while 1729 had a Bajada point and a Todsen point. Sites with Todsen points were FB75 and 495. Large scraper planes and more grinding stones were associated with this cluster of projectile points at the Keystone sites.

Fresnal. Sites of the following phase, Fresnal, were not only more numerous (51), but many were larger and had even more scraper planes, metates, and one-handed manos as well as wedge-shaped manos. Site FB593 not only had Bat Cave, Chiricahua, and La Cueva points in it, but also had a San Jose point; many sites had only San Jose points–FB4450, 3020, 520, 1516, 1508, 1876, 1890, 5712, 2243, 3745, 3760, 1391, 1530, 1623, 1710, 1746, 1728, 3021, and 1524. Site FB4705 had a San Jose as well as an Armijo point, and site 1666 had a San Jose point and a possible Augustin. The Augustin type occurred at almost as many sites–FB2071, 1601, 1637, 1512, 5777, 1542, 2661, 3233, 245, and 2690; at site 569 this type was accompanied by a Chiricahua. Chiricahua points occurred at sites FB1400, 3057, 1607, 3707, 574, 57, 226, 3010, 442, 2090, and 261. Rarer were La Cueva points, found at sites FB3012 and 598; site 585 had a La Cueva point along with an Armijo. Site FB261 had an Armijo along with a Fresnal, while only a Fresnal occurred at 4510. At FB476, there was a Fresnal along with a Hueco, while 3012 had an Augustin point and a Hueco point, the latter being typical of our final phase–Hueco. This distinctive point, with a long, expanding stem and convex base, is relatively rare in contemporaneous San Pedro sites to the west, almost nonexistent in En Medio or Basketmaker II sites to the north, and is only vaguely similar to Williams or Marcos to the east.

Hueco. A number of sites we classified as Hueco had earlier point types–FB2525 with Jay, Bat Cave, Augustin, and two Hueco; 1670 with Bat Cave, Pelona, Amargosa, Armijo, Hueco, Hatch, and En Medio points; site 63 with an Abasolo and Hueco, site 555 with Bat Cave and Hatch points, 467 with Bat Cave and Hueco, 1567 and 1691 with a Shumla and Hueco. The dominant type everywhere, however, was Hueco, which was found at sites of all sizes and shapes in the Tularosa Basin–FB4, 37, 277, 298, 2537, 535, 238, 460, 482, 499, 508, 515, 552, 856, 1552, 1635, 1653, 1660, 1665, 3014, 1690, 1712, 3617, 2502, 2524, 2179, 2230, 6086, 5721, 2131, 3108, 1749, 3220, 26, 47, 4760, 2041, 3512, 1910, 5389, 3960, 1799, 5500, 1095, 1974, 3710, 1170, 1599, 4319, 1562, 4947, 4219, 2845, 4382, 2868, 4463, 4657, 1836, 3899, and 579. Two Hueco and San Pedro Large points occurred at site 48; while a Hueco, two San Pedro Large, and a Hatch occurred at site 1668. A Hueco and a San Pedro Small occurred at sites 81 and 1550, while a Hueco and a Hatch were found at site 1671, and a Hueco and an En Medio occurred at site 1748.

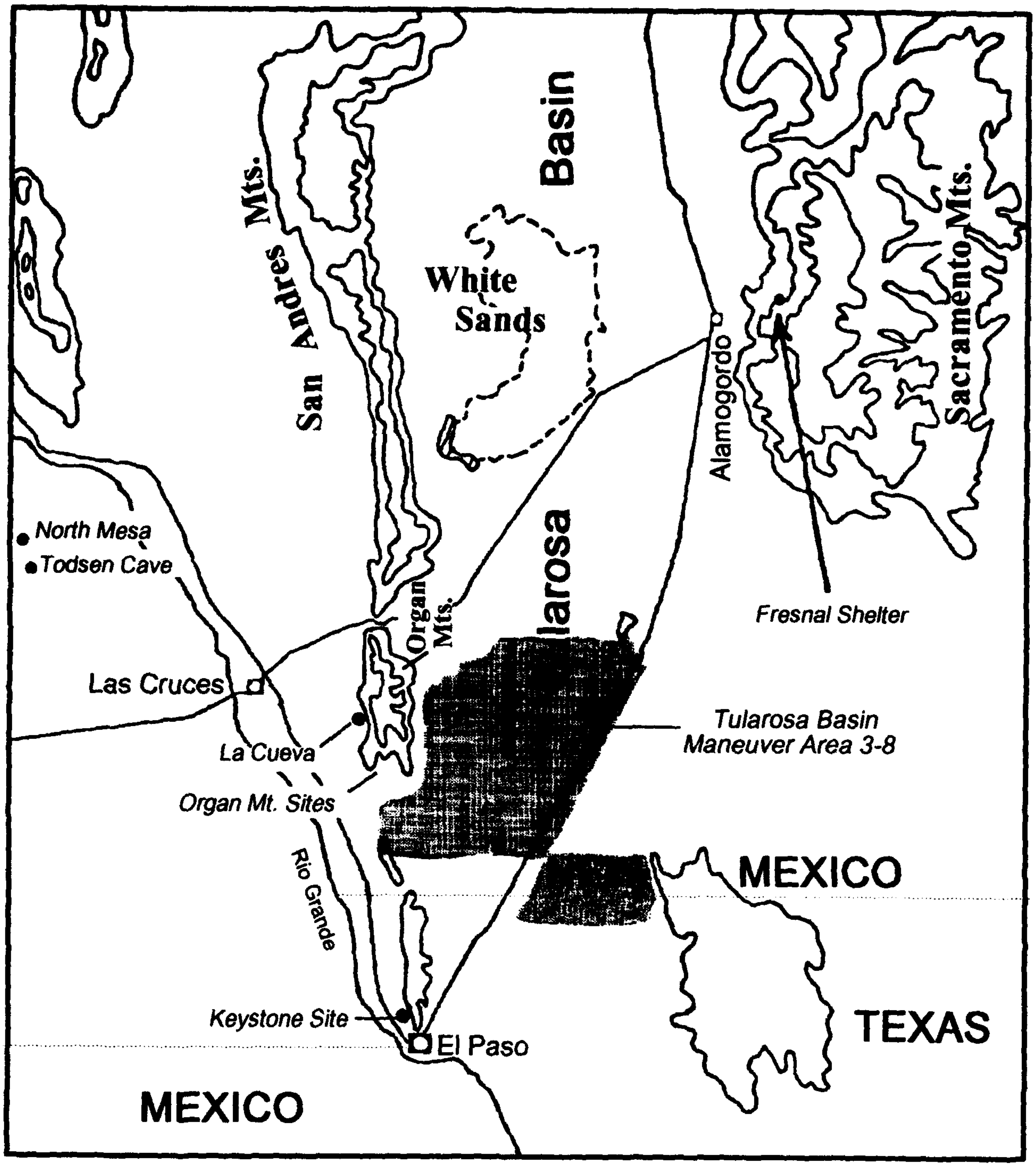


Figure II-13. Location of Tularosa Basin Survey Area and Related Sites

The second most numerous type at Hueco sites was Hatch (and some of the small Hueco perhaps should have been classified as such); these occurred at Fort Bliss sites 3648, 3044, 2132, 1718, 730, 1630, 1711, 4401, and 4903. Shumla points occurred at 1638, San Pedro Large at 664, and En Medio at 1620 and 1655. As is obvious, a dramatic increase occurred in number (87) and site size in Hueco times; this increase seems to be accompanied by more two-handed manos and metates, paint palettes, mortars and pestles, and evidence of more domesticated plant use.

In the 1988 and 1989 seasons, with the development of our coded computer system for classifying projectile points, we returned to Fort Bliss to record, measure, and check the classification of the various types. However, this analysis of points also gave us hints about changing populations and settlement patterns that Sally Anderson used to study possible seasonality and changing scheduling patterns reflecting exploitation of different ecosystems in the valley (see Chapter III). In this way, one study led to another.

Chapter III

INTERDISCIPLINARY STUDIES

Our investigation of the origin of agriculture and village life in the ancient Southwest could not reach a solution by relying on archaeology alone, so we had to bring to our aid a number of studies from other disciplines. This chapter describes the results of some of these studies as a background to our archaeological research. Chapter IV, Chronology, discusses the interdisciplinary studies--ceramic typology, obsidian hydration, and radiocarbon determinations--used for dating.

A number of our studies concerned the environment in which our research took place. We had hoped to have a soil and geological study of our local area as well as a palynological study showing changes in climate and vegetation. For various reasons, however, all that were completed were Anderson's study of ancient land use (mainly floral) and Dawson's study of the bones collected, showing ancient use of fauna.

To assist us in reconstructing the ancient subsistence systems, we planned a second set of studies--of coprolites, residue on grinding stones and ceramics, and of plants and animals on the stratified floors. The only ones that reached fruition, however, were a study of corn from the Organ Mountain caves and a study of the C13/C12 and N15/N14 isotopes found in the skeletons we uncovered as well as in a few skeletons from other sites in the area.

A third area of interdisciplinary studies concerned the ancient technology; we completed use-wear analyses of many of the stone tools, as well as flakes, and attempted an analysis of blood residue on a variety of these same tools and flakes.

All these interdisciplinary studies provided additional information that assisted us in attacking the problem of the origin of agriculture in the Southwest.

Section 1

Archaic Period Land Use in the Southern Tularosa Basin, New Mexico

Sally Anderson

The combination of new archaeological methods and greater interest in preceramic cultures has changed the study of archaeology in the Southwest. Collection and analysis of materials, intensive climatic studies, and increased recognition of Archaic materials have bolstered preceramic research. Interest in the larger problems of sedentarism and agricultural origins is resulting in an attempt to better understand preceramic lifestyles in the Southwest as well as the cultures that followed the Archaic period. These focus on technology, subsistence, and regional dynamics.

Data from archaeological and environmental studies in south-central New Mexico are helping us describe land-use patterns within the Archaic period. The foundation of the present study is an intensive surface survey of 199 nonceramic sites covering 245,000 acres known as Maneuver Area 3-8, located in the southern Tularosa Basin. Carmichael undertook this survey for the Environmental Protection Office at Fort Bliss, and recorded 243 nonceramic sites; about 174 of them were placed typologically in the Archaic period (Carmichael 1986).

Two ecological studies provide detailed vegetation, landform, and soil information for the area covered by the Maneuver Area 3-8 survey. One of these surveys covers more area (Satterwhite and Ehlen 1980), while the other provides finer detail (Budd et al. 1979). Both were used to describe the ecological areas with which this study is concerned.

The following section provides background on Archaic period studies and research concerning past climates of the Southwest. Using information from the Southern Tularosa Basin survey, Archaic period land use is presented phase by phase and related to archaeological excavations in the immediate area in order to describe settlement patterns in south-central New Mexico. Finally, the region is compared with archaeologically known regions to its north and west.

Study Area

The Southern Tularosa Basin falls within the Mexican highlands section of the Basin-and-Range province that covers approximately the southern half of Arizona, southern New Mexico, and the Mexican states of Sonora, Coahuila, and eastern Chihuahua. This province is characterized by steep, rocky mountains separating relatively level expanses of desert.

The mountain masses are the northern extremes of the Sierra Madre Oriental and the Sierra Madre Occidental of Mexico. These mountain masses, formed by faulting, trend from southeast to northwest. The desert expanses are grabens, or downthrown blocks, that are covered deeply with fill (Carmichael 1986). When these areas have internal drainage, they are called basins.

Basin slopes sometimes are referred to as *bajadas,* which geologically are defined as undissected coalescing alluvial fans. The upper bajada closely overlies bedrock, often has gravelly soil, and has a plant community that tends to be more varied than that of the lower bajada. The lower bajada has fine-grained soil containing caliche, a calcium carbonate precipitate, and overlies deep fill. The inner valley alluvium is a mixed area of cobbles; cross-bedded sand; layers of sand, silt, and clay; and layers of organic material (Martin 1963).

The archaeological sites in south-central New Mexico and the major topographic features that surround the survey area of Maneuver Area 3-8 are shown in Figure II-13. The 15,540 km^2 (6,000 m^2) Tularosa Basin is flanked on the east side by the Sacramento Mountains to the north and the Jarilla Mountains to the south. On the west, running from north to south, are the San Andres and Organ Mountains. Elevation of the Tularosa Basin floor ranges from 1,220 to 1,340 m (4,000 to 4,400 feet). To the south is the Hueco Bolson, and the division between the two basins is a slight rise called McNew Ridge. The Hueco Bolson is bounded on the east by the Hueco Mountains and on the west by the Franklin Mountains, and is much like the Tularosa Basin in sediments, topography, and biota.

The Mesilla Bolson joins the western edge of the Tularosa Basin between the Organ and Franklin Mountains, an area known as Filmore Pass. During the Pleistocene, Lake Otero at its maximum joined these basins and the ancestral

Rio Grande fed the lake. A portion of Filmore Pass is included in Maneuver Area 3-8, but the extreme southern part of the Tularosa Basin floor accounts for the largest part of the area surveyed (Carmichael 1986).

In the western part of the Hueco Bolson, rainfall averaged 220 mm (8.5 inches) per year from 1878 to 1953. The minimum recording (Whalen 1977) was 56 mm (2.2 inches) and the maximum was 465 mm (19.3 inches). A group of six measurement stations in eastern New Mexico and far western Texas showed mean annual precipitation ranging from 193 to 249 mm (7.6 to 8.5 inches). At least half of this amount falls between July and October in the form of localized thunderstorms, creating the major growing season for most grass and shrub species, while winter precipitation occurs as low intensity rain or snow. The east and west slopes show how precipitation may be influenced by mountain masses. These slopes have different plant communities, a difference that is related to the greater moisture on the east-facing slopes. In the Organ Mountains, for example, the western slopes have more xeric species–cacti, agave, desert shrubs–while the eastern slopes support forests of ponderosa pine *(Pinus ponderosa)*, mountain mahogany, large oaks, and junipers.

Mean annual temperature ranges from 14.8°C to 17.7°C (58.7°F to 63.8°F), but it should be noted that extreme variation exists in both diurnal and seasonal temperature, and the relative humidity is low (Satterwhite and Ehlen 1980). These climatic factors limit the kinds of plants that can survive and, in combination with soil conditions, have produced the vegetation that characterizes this desert.

Ecological Zones

Although Maneuver Area 3-8 includes only a few ecological areas, excavated sites of the Archaic period occur in riparian and mountain habitats as well and are included in the discussion of regional settlement patterns. Tables III-1 through III-5 show the resources of the various ecological zones.

In south-central New Mexico, landform and vegetation type correspond closely. The ecological area that makes up most (92 percent) of Maneuver Area 3-8 may be called the desert floor (Carmichael 1986). Most of the desert floor is covered by coppice dunes–rounded dunes, 0.6 to 4.6 m (2 to 25 feet) high, stabilized by mesquite growth. Mesquite often is the only plant having a 5 percent or greater ground cover on this landform. Ripple or transverse dunes occur in a few areas of deeper sand, and mesquite usually is dominant in these dunes as well. Blowouts occur where vegetation has not stabilized the sand and it has been blown away (Budd et al. 1979). Other plant species frequently found in the dune areas are snakeweed *(Gutierrezia sarothrae)*, fourwing saltbush *(Atriplex canescens)*, and grasses, especially dropseed grasses (*Sporobolus spp.*); in the ripple dunes, sand sage *(Artemesia tridentata)*, grasses, and broom dalea *(Dalea scoparia)* are most common (Satterwhite and Ehlen 1980).

Sand plains are sandy expanses where no dunes have formed, and the relief is less than 1 m (3 feet) (Budd et al. 1979). These areas often are dominated by grasses, especially *Sporobolus spp.*, or by a combination of grass and sand sage. Other grasses that grow in sandy soils are *Muhlenbergia porteri* and *Hilaria mutica* (Satterwhite and Ehlen 1980).

Shallow sand depressions, which occasionally may hold rainwater, have a finer grained soil and support stands of saltbush, mesquite, grasses, and sometimes creosote bush *(Larrea tridentata)*. Most of the depressions found in the survey area occur in a line near the base of alluvial landforms of the Organ and Franklin Mountains, although others are scattered about the basin floor. Annuals appear seasonally in the desert floor zone and may have been important to prehistoric inhabitants (Carmichael 1986).

The economically important species of the desert floor are mesquite and grasses, the dominant species; other useful species include soaptree yucca *(Yucca elata)*, fourwing saltbush, and annuals. Table III-1 indicates the zone could have been utilized from April to October, based on the flowering times of these species, with the time of greatest abundance of usable species from April through July.

Maneuver Area 3-8 includes various types of alluvial landforms–low, medium, and high alluvial fans, alluvial washes, alluvial aprons, and upland alluvial fill. The low alluvial fans and alluvial washes are grouped together as low alluvium, and the other alluvial features are called high alluvium, a division based on similarities in plant dominance.

Low-elevation fans have low relief, often are dissected (cut by ravines), and may be covered by sheetwash after rain. They occur some distance from the mountains and consist of fine sand and silt. Washes and areas of mixed low

fans and washes are composed of silt and clay and have a higher organic content that allows greater moisture retention (Carmichael 1986).

Table III-1. Resources and Seasonality of the Desert Floor*

PLANT SPECIES	FLOWERING TIME							
	M	A	M	J	J	A	S	O
Prosopos juliflora (mesquite)	X	X						
Yucca elata		X	X	X	X			
Sporobolus spp.			X	X	X			
Atriplex canescens			X	X	X	X	X	X
ANIMAL SPECIES								
Antilocarpa americana								
Lepus californicus								

Comment: Plant resources are most abundant from April through July, but mesquite pods remain on the shrubs into the fall. Use of the dried pods could make the desert floor an important resource zone for more than half the year. Animal species could be hunted all year.

*References: Kearney and Peebles 1951, MacMahon 1985, Warnock 1974, O'Laughlin 1980

Creosote and mesquite, and occasionally snakeweed, dominate the plant communities found on low alluvial features. Mesquite is dominant where blowing sand has invaded and covered areas of the fan, since creosote cannot tolerate sand deposition and dies out. Grasses dominate some parts of the low alluvial areas, especially *Hilaria mutica* and *Schleropogon brevifolius.* Other grasses, such as *Muhlenbergia spp.*, *Bouteloua curtipendula,* and *Tridens muticus,* occur on the low fans, while *Sporobolus giganteus* appears in the washes. Shrubs found in the washes are creosote bush and tarbush *(Flourensia cernua)* (Satterwhite and Ehlen 1980).

The most ecologically valuable plants in the low alluvium are mesquite, grasses, fourwing saltbush, whitethorn acacia *(Acacia constricta),* datil *Yucca spp.*, small-leaf sumac *(Rhus microphylla)*, and prickly pear *(Opuntia spp.)*. Table III-2 indicates that, as on the desert floor, mesquite and grasses might have been important and would have lasted through more than one season. Other important plants found in the low alluvium would have been most abundant from April through July.

Medium- and high-elevation alluvial fans are areas of undissected fan corresponding to the geological definition of a bajada, and are steeper than low fans. Soils in these fans are fine to medium sand and silt, although high fans may contain patches of gravel. Medium fans may be inundated during heavy rains and show signs of erosion, while high fans rarely are covered with water (Budd et al. 1979). The dominant plant on these alluvial features is creosote bush, although grasses sometimes are codominant. Grass species associated with all alluvial fans are *Bouteloua curtipendula, Muhlenbergia setifolia, Sporobolus wrightii,* and *Tridens muticus* (Satterwhite and Ehlen 1980).

Alluvial aprons usually are dissected features and are found at the base of an escarpment or continuous ridge. They are steep to moderately steep, with the steeper aprons having coarser soils. Alluvial/colluvial fans are composed of coarse materials and occur at the base of bedrock cliffs. They are very steep and are cut by recent stream activity. Plant communities on these landforms are like those of upper-elevation alluvial fans.

The economic plants in the high alluvial areas are grasses, whitethorn acacia, *Agave spp.*, Mormon tea *(Ephedra spp.)*, *Yucca spp.*, sotol *(Dasylirion wheeleri)*, *Opuntia spp.*, and cacti. Table III-3 shows these plants and their productive season; the season of greatest abundance for this zone is May through August.

Filmore Pass, technically an alluvial area, was not covered by the more detailed vegetation survey. For this reason, and because it is thought to represent a travel corridor, it has been kept separate from the other alluvial areas. The soil is a pediment type, a limestone alluvium with indurated caliche and a large gravel content (Carmichael 1986).

Table III-2. Resources and Seasonality of the Low Alluvial Zone*

PLANT SPECIES	FLOWERING TIME							
	M	A	M	J	J	A	S	O
Rhus microphylla	X	X	X					
Prosopos juliflora		X	X					
Opuntia spp.		X	X	X				
Grasses		X	X	X	X	X	X	X
Acacia constricta			X	X	X	X	X	
Atriplex canescens			X	X	X	X	X	X
ANIMAL SPECIES								
Antilocarpa americana								
Lepus californicus								

Comment: Plant and animal resources are similar in type and availability to those of the desert floor, although a few more types of seasonally available plants occur.
*References: Kearney and Peebles 1951, MacMahon 1985, Warnock 1974, O'Laughlin 1980

Table III-3. Resources and Seasonality of the High Alluvial Zone*

PLANT SPECIES	FLOWERING TIME							
	M	A	M	J	J	A	S	O
Opuntia spp.		X	X	X				
Yucca spp.		X	X	X	X			
Grasses		X	X	X	X	X	X	X
Echinocerus stramineus (hedgehog cactus)			X	X				
Echinocactus horizonthalus (barrel cactus)			X	X				
Dasylirion wheeleri			X	X	X	X		
Acacia constricta			X	X	X	X	X	
Agave spp.				X	X	X		
Ephedra spp.					X	X	X	
ANIMAL SPECIES								
Antilocarpa americana								
Lepus californicus								
Odocoileus hemionus								

Comment: A concentration of seasonally available resources occurs from May through August, although agave and sotol hearts could have been collected in any season.
*References: Kearney and Peebles 1951, MacMahon 1985, Warnock 1974, O'Laughlin 1980

Other ecological zones surrounding the Tularosa Basin are mesas, mountains, and the riparian habitat along the Rio Grande. Mesas are flat bands of sedimentary rock that have been uplifted and have steep and highly dissected es-

carpments. Grass is the dominant vegetation type, especially *Bouteloua spp.*, although in a few areas mariola *(Parthenium incanum)* or creosote bush may share dominance with the grasses (Satterwhite and Ehlen 1980).

The mountains surrounding the Tularosa Basin reach 2,700 m (8,860 feet) in elevation. The mountain valleys are composed of upland alluvial fill and are dominated by grassland *(Bouteloua spp.)*, while the slopes may be dominated by grass, communities of oak *(Quercus undulata)*, and juniper *(Juniperus monosperma)*, or occasionally by a community consisting of creosote, mariola, and grass (Satterwhite and Ehlen 1980). The highest elevations of the Organ Mountains support forests of ponderosa pine and Gambel oak *(Quercus gambelii)*, while pinyon pines *(Pinus edulis)* are found in the Sacramento range.

In the mountains oak, juniper, and grass species are the dominant plants with economic value. Associated species of importance include pinyon pine, prickly pear, datil yucca, agave, acacia, sotol, and plants that produce berries. Table III-4 demonstrates abundant resources occur from May to September. The resources unique to the mountains have a slightly later harvest time than plants such as agave, yucca, or sotol that also are found in the high alluvium.

The Southern Tularosa Basin has no permanent streams, nor is surface water common, occurring only after heavy rains when runoff is deposited in depressions. Water usually stands for only a few days, except in very wet years. The few springs in the basin are heavily mineralized, although springs flowing from Permian aquifers or volcanic formations in the Franklin, San Andres, Sacramento, and Organ Mountains provide good water sources.

Table III-4. Resources and Seasonality of the Mountains*

PLANT SPECIES	FLOWERING TIME							
	A	M	J	J	A	S	O	N
Opuntia spp.	X	X	X					
Yucca spp.	X	X	X	X				
Grasses	X	X	X	X	X	X	X	
Dasylirion wheeleri		X	X	X	X			
Acacia constricta		X	X	X	X	X		
Amelancier utahensii (Utah serviceberry)		X	X	X	X	X		
Agave spp.			X	X	X			
Ribes mescalerium (mescalero gooseberry)				X	X	X		
Vitus arizonica (wild grape)				X	X	X		
Quercus spp. (acorn)*					X	X		
*Pinus edulis**					X	X		
Juniperus spp. (juniper)*						X	X	X
ANIMAL SPECIES								
Odocoileus hemionus								
Ovis canadensis (mountain sheep)								
Sylvilagus auduboni (cottontail rabbit)								

Comment: A variety of seasonally available berries and nuts is available primarily in July, August, and September. Deer are most readily available in this zone.

*Species marked with an asterisk indicate ripening of fruits or nuts rather than flowering time.

*References: Kearney and Peebles 1951, MacMahon 1985, Warnock 1974, O'Laughlin 1980.

The Rio Grande flows along the west side of the Organ and Franklin Mountains (as shown in Figure II-13) and creates a riparian ecological zone that can be reached easily from the basin via Filmore Pass, a distance of about 10 km (6 miles). Sites from all prehistoric periods have been found in the pass and may reflect the importance of the riparian zone to the people who used the basin (Carmichael 1986).

Today the Rio Grande has been dammed and stabilized and the floodplain mostly is under cultivation, but a few areas thought to represent the former vegetation pattern survive. Riparian vegetation refers to plants that grow along watercourses and on their floodplains; they comprise a different group of plants from that adapted to the surrounding desert. Along larger rivers the riparian vegetation zone includes the watercourse and well-developed terraces that parallel the stream. The first terrace is the area covered by normal flooding. Willows *(Salix spp.)* and cottonwoods *(Populus spp.)* grow closest to the water, and other plants include arrow weed *(Pluchea sericea)* and tornillo *(Prosopis pubescens)*.

On the second terrace is mesquite, which can form dense thickets, and desert willow *(Chilopsis linearis)*, seep willow *(Baccharis glutinosa)*, Apache plume *(Fallugia paradoxa)*, and *Acacia spp.* The greater diversity and taller, thicker vegetation on these terraces provide shelter for animals. Distributions of 50 to 80 percent of desert animal species in the western United States are thought to be influenced by the location of riparian environments (MacMahon 1985).

Economically important species of the Rio Grande floodplain are tornillo, mesquite, dock *(Rumex spp.)*, cattail *(Typha latifolia)*, purslane *(Portulaca oleraceae)*, and fourwing saltbush (O'Laughlin 1980). Table III-5 indicates most plants would be available in April, May, and June, but O'Laughlin argues, based on the presence of mud shelters, that the Keystone Dam sites were occupied during the winter months and were used intermittently during other seasons since plant remains from the various seasons were found there.

Table III-5. Resources and Seasonality of the Riparian Zone*

PLANT SPECIES	FLOWERING TIME											
	N	D	J	F	M	A	M	J	J	A	S	O
Lycium pallidum (pale wolfberry)				X	X	X	X	X	X	X		
Typha latifolia					X	X	X					
Rumex spp.					X	X	X	X				
Prosopis pubescens						X	X					
Atriplex canescens							X	X	X	X	X	X
Portulaca oleraceae								X	X	X	X	
ANIMAL SPECIES												
Lepus californicus												
Odocoileus hemionus												
Sylvilagus auduboni (cottontail rabbit)												
Turtles (family *Emydidae*)	X				X	X	X	X	X	X	X	X
Waterfowl (family *Anatidae*)	X	X	X	X								
Fish	X	X	X	X	X	X	X	X	X	X	X	X

Comment: Plant species are available in the greatest amounts in April, May, and June, but cattail roots can be used throughout the year.

*References: Kearney and Peebles 1951, MacMahon 1985, Warnock 1974, O'Laughlin 1980.

Geological features of the Tularosa basin, especially outcroppings of stone used for tools, were important to prehistoric inhabitants (Carmichael 1986). Chert and rhyolite are the two most important lithic materials for chipped stone tools; other types of stone are limestone, quartzite, basalt, obsidian, jasper, silicified shale, and welded tuff. Outcrops of some of these types of stone occur in mountains surrounding the basin, but those not found cannot necessarily be considered exotics or imported materials. Obsidian, certain types of chert, jasper, and quartzite are found in mixed gravels from Filmore Pass as a result of the Rio Grande having flowed there in the past, and these gravels may be the source for other so-called exotics since the full range of types available has not been documented.

Ground stone artifacts among the survey materials from the basin were made from limestone, sandstone, vesicular basalt, and schist, but various granitic types are most abundant locally and were used most commonly.

Archaic Sites from the El Paso Area

The Archaic sites from the El Paso area are described in two groups, survey sites and excavated sites. The survey sites are those from Maneuver Area 3-8; all information comes from surface collections of lithic artifacts on the basin floor and surrounding alluvium. The excavated sites do not represent a systematic search for Archaic sites and therefore may not reflect spatial distribution of prehistoric populations accurately. They do, however, document use of various ecological areas and provide information on perishable remains.

Survey Sites. A total of 243 aceramic components was recorded on the Maneuver Area 3-8 survey. Carmichael treated the problem of site multicomponency in his survey report, defining a component as "the archaeological manifestations of constituent elements of temporally distinct subsistence systems." Failure to recognize multicomponent sites in published data may have been responsible for the lack of documented preceramic occupations in previous surveys. Therefore, Carmichael developed a projectile point typology for the basin and measured the diversity of lithic materials in order to assure recognition of preceramic components (Carmichael 1986).

Several problems still complicate chronological placement of the sites. First, a number of sites do not contain materials that allow them to be fitted into a finer chronological scheme. Specifically, aceramic sites having no projectile points cannot be placed temporally, and some Late Archaic projectile point styles overlap with the Early Ceramic period so that Archaic components still can be overlooked on Ceramic sites. Curation and reuse of tools by later inhabitants of an area can cause later sites to be assigned to earlier periods. Finally, it is important to remember that the data come from surface survey; data from excavation of these same sites might alter any conclusions drawn about components or site type.

Of the 243 aceramic sites, 70 are omitted from this analysis because of lack of datable remains. Based on lithic material diversity, some of these probably are Archaic sites, but this characteristic is not specific enough to assign a component to one of the phases. Seventeen more sites have been excluded because of lack of data on site location or lack of environmental information. The remaining 156 sites have been placed in one of the four Archaic phases–Gardner Springs, Keystone, Fresnal, and Hueco–located with respect to landforms, and assigned one of the following categories:

- Macroband–four or more hearths or large amounts of ground stone
- Microband–one to three hearths
- Task Force–usually no hearths, occasionally one (depending on artifacts present)

The percentage of sites found in each landform category is summarized in Table III-6 and can be compared to the percentage of that landform covered by the survey. This comparison emphasizes the fact that while the number of sites in each landform may seem very unequal, some of the difference is explained by the extreme difference in the area of each landform surveyed. It also is easy to see that some areas, for instance Filmore Pass, have a greater-than-expected number of sites.

Trends in site location and site type are shown by the data from the survey (see Table III-7). First, there are no sites in the alluvial landforms during the Gardner Springs and Keystone phases; only two sites in the low alluvium date to the Fresnal phase. Only during the Hueco phase are there many sites (percentage-wise) in the alluvial areas.

Carmichael (1986) has pointed out that erosion and deposition that take place on the alluvial slopes create a built-in bias in the data, meaning earlier sites are more likely to be covered. Possibly the Boulder Canyon surface survey and subsurface testing program now in progress on the alluvial and lower mountain areas of Fort Bliss will clarify the question of early sites in these landforms. In this survey material, however, it appears that resources of the alluvial slopes are utilized only in the later Archaic.

The Filmore Pass area makes up 2 percent of the survey area and has a greater-than-expected percentage of sites in most phases. As previously mentioned, the use of this pass as a travel corridor from the basin to the Rio Grande may account for the high percentage of sites found there.

The number of sites on the desert floor differs little from the expected amount, but the number seems to decline in the Fresnal and Hueco phases. While this decline is small, it fits into a pattern of continually declining percentages of sites on the desert floor throughout the Prehistoric period (Carmichael 1986).

An obvious trend in the survey data is an increase in total number of sites during the last two phases of the Archaic period. A threefold increase occurs from Keystone to Fresnal, and the number doubles from Fresnal to Hueco, as shown in Figure III-1. The graph also shows change in proportion of site types, which may reflect differences in social organization and in the subsistence system. In the Gardner Springs and Keystone phases the types of sites are divided relatively evenly between task force, microband, and macroband occupations. During Fresnal, task force and macroband sites increase in number in relation to the number of microband sites. This trend toward larger sites with many task force or specialized occupations intensifies during Hueco, when almost a third of the sites are macroband occupations and half are task force camps, leaving only a small number of microband camps.

Fred Plog (1974) has tried to show that a transition toward a more specialized economy would be represented by a pattern of larger sites combined with many special activity sites. However, the data do not show much difference in the location of the various site types from the survey in relation to landforms, and Carmichael concluded that little functional difference existed among the sites. Another explanation would be that the large sites either represent multiple reoccupation at a site location (Beal 1981; Carmichael 1986) or that multicomponent sites have large Ceramic period occupations. This problem occurs because recorded sites include all parts of a multicomponent occupation.

Carmichael used the presence of middens as a guide to habitation sites when no structures were found. In the survey data pertinent to this study, no structures and no middens are associated with the Archaic components. Five Fresnal phase components and two Hueco phase components occur on sites having middens, but in each case ceramics occur on the site and are associated with the middens. It is concluded that no habitation sites of the Archaic period were located by the Maneuver Area 3-8 survey (Carmichael 1986).

Two questions often asked in Southwestern archaeology are whether there is continuity between Paleo-Indian and Archaic populations or those of the Archaic and Formative periods, and how the known archaeological areas are related to one another. Sayles thought the Cochise tradition derived from a generalized food-gathering base (Sayles 1983), while Haury believed it was connected to the Clovis hunters (Haury 1983). The Colorado Plateau may have been inhabited and then abandoned by social groups of the Cody culture with a subsistence pattern based on herd-animal hunting. Later the area was reoccupied by Archaic groups known as the Oshara tradition, which had a more generalized subsistence strategy (Irwin-Williams 1979).

The data for the Southern Tularosa Basin might support the argument that there was continuity between the paleo-Indian and Archaic peoples. The Paleo-Indian settlement pattern for the survey sites is described as dispersed, with most components located on the desert floor, and others located in Filmore Pass (Carmichael 1986). The same pattern occurs in the Gardner Springs components from the survey.

Using data from single-component sites in the survey, mean distance to the nearest playa was calculated and the periods were compared. No significant difference was found between the Paleo-Indian and Archaic periods. Furthermore, ground stone implements were found at six sites defined as Paleo-Indian components. A measure of projectile point width, another trait thought to vary temporally (decreasing through time), was similar for Paleo-Indian and Early Archaic points, while all other time periods compared showed significant differences. Finally, a measure of lithic diversity based on the number of chert types found was used to compare the periods. This test did show a difference between Paleo-Indian and Archaic periods (Carmichael 1986).

Table III-6. Percentage of Landform Types in Maneuver Area 3-8 and Percentage of Sites in each Landform by Phase

	LANDFORM GROUPS			
	Desert Floor	**Low Alluvium**	**High Alluvium**	**Filmore Pass**
Survey Area	92%	3%	3%	2%
Hueco	87.1%	2.3%	4.7%	5.9%
Fresnal	88.4%	4.7%		6.9%
Keystone	100%			
Gardner Springs	92.8%			7.2%

Table III-7. Number of Sites from Maneuver Area 3-8, in Each Landform, by Phase and Site Type

PHASE AND SITE TYPE	DESERT FLOOR	LOW ALLUVIUM	HIGH ALLUVIUM	FILMORE PASS	TOTALS
Hueco					
Macroband	20	1	2	2	**25**
Microband	11				**11**
Task Force	43	1	2	3	**49**
Totals	**74**	**2**	**4**	**5**	**85**
Fresnal					
Macroband	15	1		2	**18**
Microband	7	1			**8**
Task Force	16			1	**17**
Totals	**38**	**2**		**3**	**43**
Keystone					
Macroband	5				**5**
Microband	5				**5**
Task Force	4				**4**
Totals	**14**				**14**
Gardner Springs					
Macroband	4				**4**
Microband	4				**4**
Task Force	5			1	**6**
Totals	**13**			**1**	**14**

Although there are distinct lithic assemblages between the Paleo-Indian and Archaic period sites in the survey area, grinding stones may be associated with both periods, and the settlement pattern shows continuity. Faunal remains from a site near the survey area contained bones of bison, antelope, and bighorn sheep (Wimberly and Eidenbach 1981).

In Carmichael's discussion of the transition from Hueco to Mesilla, the earliest Ceramic phase, he suggests the appearance of the first ceramics may have little importance in a model of adaptive change. Projectile point styles show continuity between the Late Archaic and Early Formative assemblages, based on the occurrence of some types in ceramic and aceramic contexts, and similar lithic resources were used. Continuity in site distribution from the Late Archaic to the Mesilla phase was demonstrated by nearest neighbor statistics. Both of these groups have a low percentage of habitation sites in the area surveyed, and pithouse construction from the Mesilla phase is similar to that of the Archaic period pithouses excavated at Keystone Dam.

Excavated Sites. Settlement pattern and subsistence data at the following excavated sites are thought to be related to the sites in the Tularosa Basin. Artifact assemblages from these sites therefore were included with the Maneuver Area 3-8 survey materials to determine assemblages for the Archaic phases. Figure II-13 shows that Fresnal Rockshelter is located in the Sacramento Mountains, and the Gardner Springs site is in the San Andres range. The Organ Mountain rockshelters–Rincon, Knee Pad, Tornillo, Roller Skate, Thorn, and Sonrisa–are at the southern end of the Organ Mountains, while Hermit Cave is about 150 km (94 miles) east of El Paso in the Guadalupe Mountains. Chavez Cave is on the Rio Grande near Las Cruces, while Todsen Cave is in a small canyon that leads into the Rio Grande from the west. The only open site outside of the Tularosa Basin is at Keystone Dam, which is located northwest of El Paso.

Subsistence and seasonality information from the various excavated Archaic rockshelters and the open sites just now is becoming available for the separate phases because of their recent definition. Reported animal remains from Fresnal Shelter date from 6000 to 900 B.C. and were analyzed as a group. Remains of mule deer, American bison *(Bison bison),* pronghorn antelope, and bighorn sheep indicate large mammal hunting, and the age of the bones suggests a midsummer to late fall season for the use of the shelter (Wimberly and Eidenbach 1981).

Plant remains from Fresnal were reported for levels dating from 1600 B.C. to A.D. 1, and 11 subsistence items were accorded major importance since they were found in eight of every 10 samples. Ten of these were perennial species, and it was suggested that many hunting and gathering groups depended on perennial plants because they provided a reliable food source in a known location. These species were fourwing saltbush, buffalo gourd *(Cucurbita foetidissima),* juniper, four o'clock *(Mirabilis multiflora),* mesquite, grasses *(Sporobolus spp.*, panicea tribe, and *Stipa neomexicana),* Turkshead cactus, prickly pear, and *Amaranthus spp.* Less common plant remains were maize, composite flower heads, beans, yucca, pinyon nuts, fruits, and acorns (Bohrer 1981). These plants would have come from low alluvial, high alluvial, and mountain ecological zones and could have been collected in abundance from May through September.

Two seasons of excavation at Todsen Cave and analysis of the artifacts recovered have led MacNeish to suggest a winter and spring occupation that emphasized hunting there. The rockshelter was occupied throughout the Archaic period, and would belong to an area that has been called the leeward slope (O'Laughlin 1980). Yucca, ephedra, juniper, prickly pear, little-leaf sumac, grasses, mesquite, and annuals presently are found there, and the site provides easy access to the Rio Grande. Hunting would focus on the abundant jackrabbits in the vicinity, although deer and cottontail rabbits also might be taken.

The Gardner Springs site, which dates to the earliest part of the Archaic, has no subsistence data. Tool types include projectile points and grinding stones thought to be used for processing grasses (Beckett and MacNeish 1987).

The open site at Keystone Dam has two occupation areas with extensive remains of structures. One of these areas has 23 to 41 shallow pithouses assigned to the Archaic period. The earliest radiocarbon date is about 2790 B.C.; after about 1800 B.C., the site was abandoned until the end of the Archaic.

Floral and faunal resources indicate Keystone occupations were from fall to spring, according to O'Laughlin, while mud house construction supports winter residence. Since this site is located close to the Rio Grande and within easy reach of resource zones from the river to the mountains, year-round permanent residence or intermittent use during the year could have taken place.

The series of excavated caves in the southern end of the Organ Mountains spans the Archaic period. Peña Blanca

and Rincon were occupied during the Gardner Springs phase, while Rincon and Roller Skate were used during Keystone; the Fresnal phase was represented by Tornillo and Sonrisa. Peña Blanca, Knee Pad, Tornillo, Roller Skate, Sonrisa, and Thorn rockshelters were used during the Hueco phase; most of these shelters also have Ceramic period occupations. The caves are near resources that are available in summer and early fall (MacNeish, personal communication). The North Mesa site also appears to have been occupied in this same season, when the opuntia, sotol, and agave reached fruition.

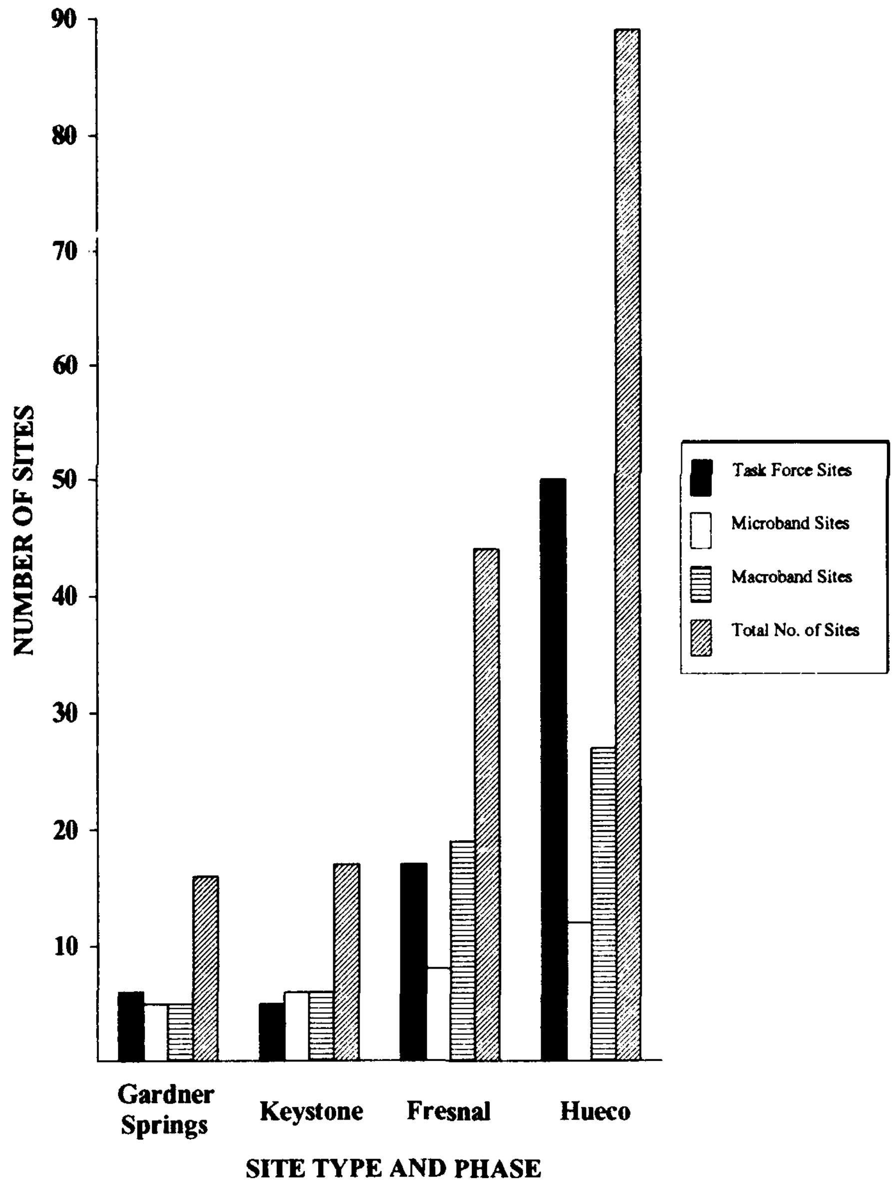


Figure III-1. Archaic Site Types

Few details are available about the plant remains from these Organ Mountain shelters, although a sequence of early maize types has been recovered from them. Chapalote was found in Late Fresnal phase deposits, and Chapalote and Proto-Maiz de Ocho were recovered in the earliest Hueco phase deposits. The Proto-Maiz de Ocho, which may be a product of local selection for drought resistance, is thought to have spread throughout the Southwest. Deposits from around A.D. 1 contain Maiz de Ocho and some Pima-Papago maize, both believed to be derived from the Proto-Maiz de Ocho (Beckett and MacNeish 1987). No archaeological evidence has been reported in the Southwest for the Mexican method of processing maize by soaking the kernels in lime water before grinding (Woodbury and Zubrow 1979). Ethnohistorical accounts describe maize preparation as dry grinding of the kernels or roasting the ears before removing and grinding the kernels.

Hermit Cave and Chavez Cave were excavated before 1940 and few details were collected about subsistence. Both caves probably were occupied during the Hueco phase. Hermit Cave deposits contained matted vegetal matter composed of leaves, twigs, cacti, beargrass, agave, sotol leaves, and grass. Six storage pits were found, most lined with mats, bark, and grass. One pit was slab lined and contained baked sotol leaves. Various artifacts were found in the other pits, but often agave and sotol hearts were among the items (Ferdon 1946).

Chavez Cave and caves in the Hueco Mountains excavated in the 1920s by Cosgrove (Cosgrove 1947) contained many prehistoric artifacts, and many of the caves seem to have had preceramic levels. Little attention was given to stratigraphy or context during the excavation, however, and useful information about the Archaic therefore is scant. Many types of netting and cordage came from Chavez Cave; remains of edible plants included small corncobs, husks, quids, and squash and gourd rinds. Bones of deer, antelope, rabbit, duck, and fish were reported. Chavez Cave is very large compared to other shelters in the area and may have been a base camp or winter season camp during the Late Archaic.

The Hueco Mountain caves contained maize, squash, gourds, mesquite, yucca, grass seeds, quids, and bundles of herbs. Bones recovered include mule deer, antelope, dog, cottontail rabbit, squirrel, badger, tortoise, coyote, hawk, owl, and condor. Tools of wood, bone, and antler were numerous, as were cordage and woven artifacts. Also collected were ornaments and ceremonial items. The Hueco Mountain caves seem similar to Fresnal Shelter and, based on the resources available, could have had summer and fall occupations.

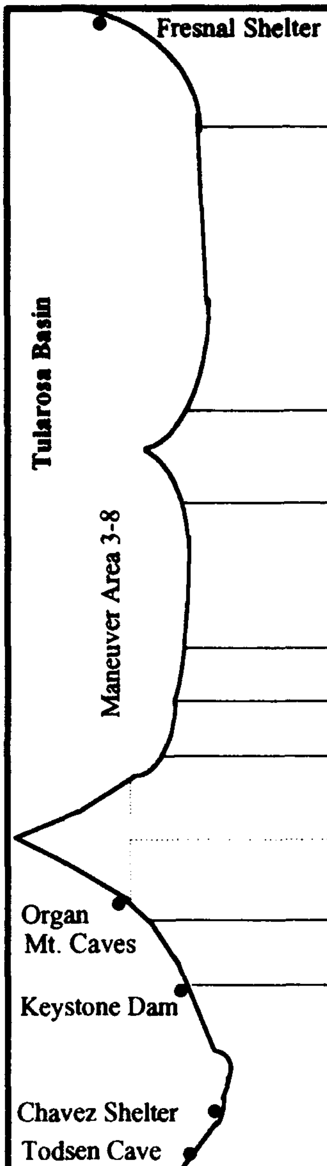
Settlement Systems

The Archaic period involved adaptation to a broad spectrum of plant and animal resources. Although plant collecting had been inferred for paleo-Indian populations and hunting was an important element of Archaic subsistence, associated artifacts imply a shift in importance toward plant collecting and less emphasis on hunting. Other characteristics of the Archaic include hunting for smaller animal species, exploitation of aquatic resources, the addition of new plant foods to the diet, and new food preparation techniques (Willey and Phillips 1958). Although the Archaic is emphasized here as a time period rather than an evolutionary stage, the kinds of evidence found support the view of it as a time of evolution.

Social organization during the Archaic period usually is assumed to have been of a band type, the model being the Great Basin Shoshone pattern. The evidence presented here, however, is one of change. Increase in band size and changes in group organization, more sedentary occupations, and reliance on a more diverse subsistence base, eventually including cultivated plants, are processes occurring during the Archaic. The information from survey and excavated sites can be applied to these general ideas in order to create a better diachronic model of the Archaic developments and to learn more about local developments.

Implements used in pursuit of game, for collecting plants, and for processing subsistence items, as well as the plant and animal remains themselves, are the usual means of determining subsistence patterns. In an analysis based on survey material, environmental zones can be used to suggest use of certain resources, and the availability of the resources can lead to ideas about seasonal movements.

Carmichael (1986) noted Archaic populations in the survey area occupied more of the different landform types than Paleo-Indian or ceramic-using groups. The division of the Archaic into four phases provides more data about the expansion into the various ecological zones, which occurred after 2500 B.C. The settlement systems for each of the phases are based on data summarized by Figure III-2.



AREA	SEASON	Hueco	Fresnal	Keystone	Gardner Springs
Sacramento Mountains	summer, early fall	□	□	□	□
Jarilla Mountains	late spring, summer	■			
Desert Floor	late spring, summer, early fall	○ □ ■	○ □ ■	○ □ ■	○ □ ■
Low Alluvium	late spring, early summer	○ ■	○ ■		
High Alluvium	summer	○			
Filmore Pass	late spring, summer	○ ■	○ ■		○
Organ Mountains	summer, early fall	○ □ ■	○ □	○	○
Alluvium					
Rio Grande	late fall, winter, early spring	○ ●	● ○	● ○	○

KEY:
● = Base Camp ■ = Macroband □ = Microband ○ = Task Force

Figure III-2. Profile of Maneuver Area 3-8 and Surrounding Ecological Zones with Seasons of Resource Availability. Site types for the four Archaic phases are shown in the areas where they occur.

Gardner Springs Phase. Settlement and subsistence evidence for the Gardner Springs phase comes from 14 survey sites (see Figure III-3), Fresnal Shelter, Todsen Cave, Gardner Springs, Peña Blanca, and Rincon. Basin sites produced grinding stones and projectile points at sites of all sizes. The early grinding stone types probably were used to process seeds of grasses and maybe annual plants (Carmichael 1986), products that would have been available in large quantities and that could have been harvested from April until October. Jackrabbit and antelope could have been hunted at any time, and possibly other larger animals, such as bison, would have been available (O'Laughlin 1980).

Mountain rockshelters seem most likely to have been inhabited during summer and early fall, based on available resources, and bones from Fresnal Shelter indicated this as well. Deer would have been the most important animal resource, although other large mammal bones were found (Wimberly and Eidenbach 1981). A transition from Paleo-Indian big-game hunting to hunting of smaller species, thought to characterize the Archaic, might be shown by the presence of the larger mammal bones.

The Organ Mountain caves also are believed to have been used in summer and early fall based on the plant resources there, although seasonal evidence has not been reported from these excavations yet. Todsen Cave may be an example of a low-elevation winter hunting camp, a conclusion based on the chipped stone tools found in early levels (MacNeish, personal communication), while North Mesa is late summer and Fresnal would be fall.

Base camps and structures are not known for the Gardner Springs phase. Examples of base camps belonging to the Paleo-Indian period are said to occur in the basin to the east of the survey area and along the Rio Grande (Carmichael 1986), so it is possible Early Archaic base camps eventually will be found.

If these assumptions about seasonality are correct and base camps are not found, then the Early Archaic must be said to show a pattern of seasonal movement by small groups of people. Even sites defined as being occupied by macrobands are rather small during this Gardner Springs phase. The basin would be utilized during late spring and early summer, and as the seasonal resources became available in the mountains in summer and early fall, people would have moved their camps to locations such as Fresnal Shelter to collect those resources. Perhaps the shelter provided by the caves was important during these months because it was the peak of the rainy season. Use of the basin might have occurred again in the fall before a return to winter camp, which might be represented by Todsen Cave near the Rio Grande.

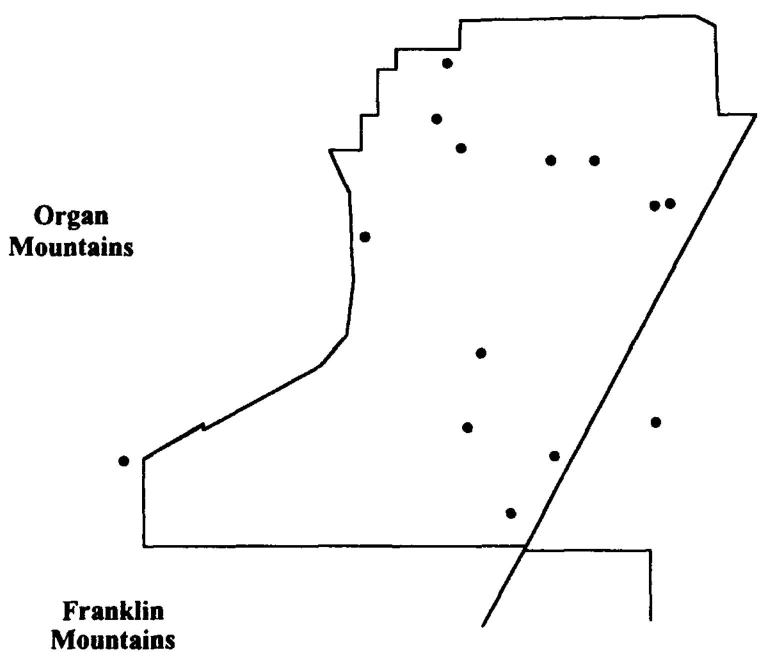


Figure III-3. Maneuver Area 3-8 Sites, Gardner Springs Phase

Keystone Phase. Fourteen survey sites (see Figure III-4) have provided settlement data for this phase (while nine did not), along with Fresnal Shelter, Todsen Cave, Rincon and Roller Skate rockshelters, and Keystone Dam. Survey sites show continuity with the Gardner Springs phase, since all sites are located in the desert floor, and none are very large or functionally specific.

Evidence that can be cited for Fresnal Shelter is the same as that given for the Gardner Springs phase; in other words, a summer and early fall occupation is indicated by the plant resources of the area, and deer would have been the major animal species hunted.

While mullers and milling stones are a part of the Early Archaic assemblage, other plant-processing tools appear in the following phases. The appearance of more specific tools, often specifically preformed, that relate to the processing of new foods often is cited as a characteristic of the Archaic period. At Todsen Cave, metates appear for the first time during this phase. They are distinguished by use-wear that shows a back-and-forth motion rather than the circular motion seen on milling stones; this back-and-forth pattern is said to indicate maize grinding rather than small-seed processing. Again, Todsen Cave is presumed to have a winter or early spring occupation (Beckett and MacNeish 1987).

In the Organ Mountains, occupation at Rincon Cave and Roller Skate Cave is associated with the Keystone phase, but again specific data are not available concerning plant remains. Based on resource availability, a summer and early fall occupation is suggested for these occupations, as well as for North Mesa.

The most important change in this phase is the probable occupation of the Keystone Dam site, where one pithouse has been radiocarbon dated to the latter part of the phase. Many more structures date to the Fresnal phase. The shallow, circular houses are about 1.5 to 4 m in diameter, 20 to 50 cm deep, and have unplastered floors. The walls and roof were mud plastered over a dome-shaped structure made of grass and brush, and the houses had hearths and probably an east entry.

Trash-filled pits, one possible storage pit, burned food remains, and a wide range of activities inferred from chipped and ground stone artifacts led O'Laughlin to suggest permanent residence at the site. On the other hand, unplastered floors, flimsy construction materials, the informal hearth, a large amount of debris on some floors, and his interpretation that the burning of many houses was intentional were arguments indicating a more intermittent use of the site. He suggested a winter period of residence because of cold and damp weather conditions. O'Laughlin seems to have concluded that seasonal occupation with frequent intermittent use the rest of the year was the most likely pattern of site use (O'Laughlin 1980).

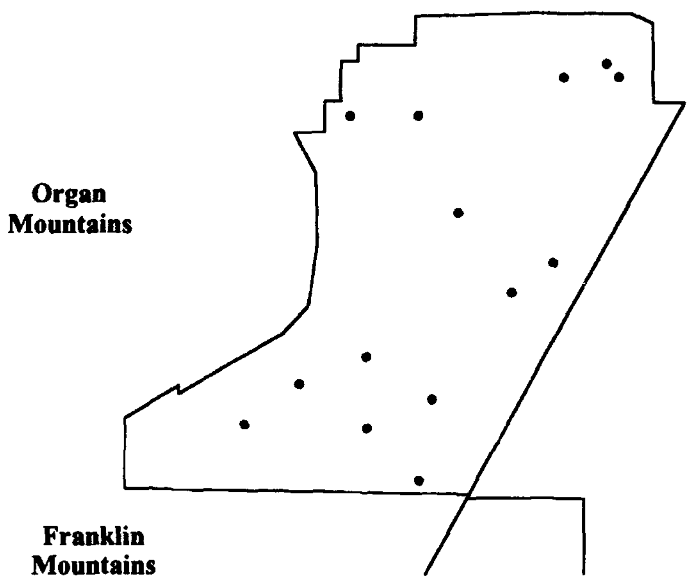


Figure III-4. Maneuver Area 3-8 Sites, Keystone Phase

Despite the Keystone Dam pithouse, the best interpretation for the settlement system of the Keystone phase may be much like that for Gardner Springs, since the date for the house falls into the latter part of Keystone. By the end of the phase, however, the evidence for the base camp changes the picture, and a more sedentary population can be hypothesized, although visits continue to be made to other resource areas.

Fresnal Phase. Contributing information to the Fresnal phase settlement pattern analysis are 43 survey sites (see Figure III-5) and the excavated sites of Fresnal Shelter, Sonrisa and Tornillo Caves in the Organ Mountains, Todsen Cave, North Mesa, and the Keystone Dam site. As mentioned before, many more sites in the survey belong to this phase than was true of previous phases; also, a change in proportions of site types occurred. For the first time, sites were located in alluvial features of the survey area, which may indicate use of these areas for dry-land farming since low- and medium-elevation alluvium is inundated after rainfall. Outside the survey area, the same range of site locations occurs as in the previous phase.

Some of the plant remains from Fresnal Shelter, with dates ranging from 1600 B.C. to A.D. 1, must belong to this phase. It was assumed the wild plants collected in earlier phases would have been like the ones from the analyzed sample. We may, however, be able to add cultivated plants to the list of foods used in the Fresnal phase, since both maize and cucurbits were reported from this rockshelter (Bohrer 1981).

Maize also was reported to have been found at the Keystone Dam site (Beckett and MacNeish 1987), which had an extensive occupation of 23 to 41 pithouses, as described above, most dating between 2500 and 1800 B.C. Although it cannot be shown by dating methods that all of the houses were occupied simultaneously, little overlap of floor space occurs, and the houses appear to have been arranged in clusters of two to five. Because these houses were flimsy structures, it was argued that the site represented a base or multiseason camp rather than a permanent habitation (O'Laughlin 1980).

During the Fresnal phase manos and metates make up part of the ground stone assemblage at survey and excavation sites; in fact, they outnumber mullers and milling stones during this time (Beckett and MacNeish 1987). Other than the new tool assemblages, no new information can be added about North Mesa, Todsen, Sonrisa, or Tornillo Caves during this phase; these sites continued to be occupied by microband groups in the same seasons as during the Keystone phase.

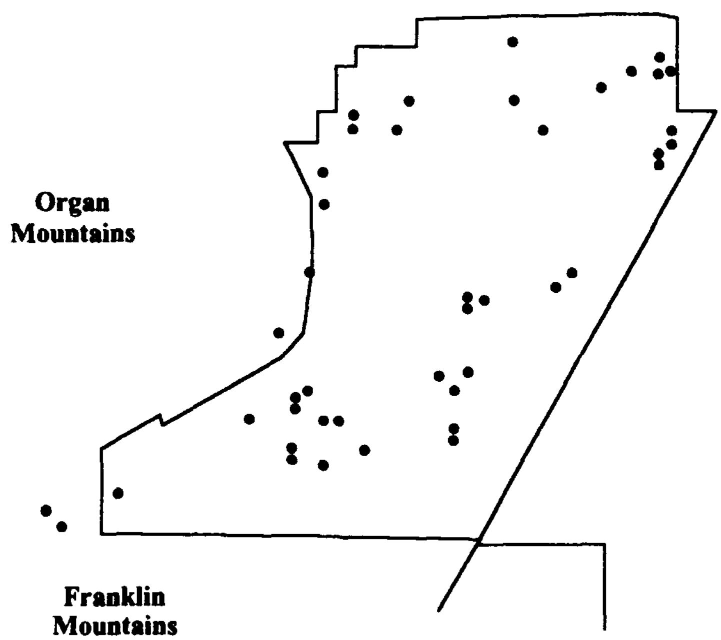


Figure III-5. Maneuver Area 3-8 Sites, Fresnal Phase

The use of storage pits would permit changes in seasonal scheduling for resources, and archaeological evidence of storage pits might indicate a change has occurred. A number of pits were found with the houses at Keystone Dam, but only one of these was considered a storage pit (O'Laughlin 1980). Food storage was implied at Todsen and Fresnal Shelter because of the storage quality of some of the plant species found there, but details of storage facilities were not reported (Bohrer 1981).

Although the resources exploited during the seasonal round may have been much the same as they were during Keystone, solid evidence exists for the use of base camps, domesticated plants, and storage facilities, and growth of sites toward larger camps and task force sites. While the same resources were being exploited in similar locations, time was spent at the base camp and short trips were made to other locations.

Hueco Phase. Eighty-five survey sites (see Figure III-6) are attributable to the Hueco phase, a substantial increase, and the number of cave sites occupied is greater than before. These excavated sites include Fresnal Shelter, Hermit Cave, Chavez Cave, Todsen Cave, some caves in the Hueco Mountains, and many of the Organ Mountain rockshelters.

Arguing against increasing sedentarism is the fact that Keystone Dam, which was considered a base camp in previous phases, was not used for such during the Hueco period; however, it is possible larger caves were used for base camps during this phase. Use of caves such as Chavez is difficult to evaluate since their remains have been removed or badly disturbed. Although material remains from the Hueco Mountain caves contained a wide range of artifact types, all Archaic materials were removed without contextual information, so the importance of these caves cannot be demonstrated. Fresnal Shelter was considered a seasonal site throughout its occupation (Wimberly and Eidenbach 1981), and the small size and number of artifact types at the Organ Mountain shelters, Todsen Cave, and the North Mesa site would argue against their use as base camps.

During the Hueco phase, for the first time, the number of survey sites in the alluvial areas of the basin is greater than expected based on the percentage of alluvial landform areas surveyed. Dry-land farming was suggested as the reason for alluvial site locations when they appeared in the Fresnal phase. Carmichael (1986) noted that only kernels and cupules had been found at excavated sites in the basin, and he believes proximity to farming areas would be better demonstrated if roots and stalks also had been found. This possibility would depend on the harvesting method, although plant parts, such as husks and cobs, are known from excavated sites and might more likely be expected to be found.

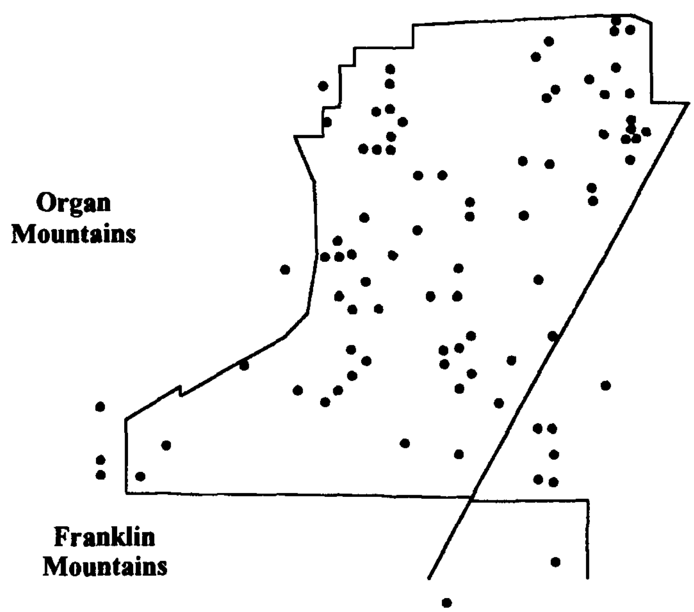


Figure III-6. Maneuver Area 3-8 Sites, Hueco Phase

Trough metates and wedge manos are the typical grinding stones of the Hueco phase, along with true pestles and bedrock mortars (Beckett and MacNeish 1987). This change in processing tools accompanies increased evidence for maize at the Organ Mountain caves, Fresnal Shelter, the Hueco Mountain caves, Todsen Cave, North Mesa, and Chavez Cave.

Most of the increase in survey sites occurs in the number of task force occupations, possibly reflecting an increase in the use of base camps and forays by small groups of foragers. The many small sites in the basin may have served as processing sites for grass seed or for mesquite, a conclusion based on the increased number of pestles and their location near playas where mesquite stands would have been found in a desert grassland. Pestles are documented in the ethnographic literature as mesquite-processing tools; their number is largest during the Late Archaic and Mesilla phases, after which they decline.

Basin sites also might have been important for jackrabbit hunting. Such camps were found commonly during the Mesilla phase, and the possibility should be considered that they occurred earlier (Carmichael 1986).

Another type of special activity site that appears in the Hueco phase is the succulent-processing site, of which Hermit Cave could be an example. No cultivated plants were found there, but many excavated storage pits contained agave and sotol hearts, and it is possible the site was used for the purpose of gathering and preparing this food. The Keystone Dam site was not used after the Fresnal phase until the very end of the Hueco phase, at which time it also may have been a succulent-processing site (Ferdon 1946; O'Laughlin 1980), as was North Mesa.

A hypothetical settlement system for the Hueco phase might be based on the multiseasonal or base camp use of a site such as Chavez Cave. Open-site base camps with pithouses may have existed, but have not been found. Based on the occurrence of large numbers of task force sites found by the survey, and special activity sites for hunting or succulent preparation, much foraging might have been conducted from a more permanent base. Turtles and fish came into use in the Fresnal phase and continued into the Hueco phase, as seen by remains of these animals from Chavez Cave. O'Laughlin (1980) has suggested aquatic resources might have provided a winter supplement to a late Archaic economy that was based partly on horticulture.

Heavy use of the Organ Mountain caves and evidence of domesticated plants at those sites might represent the use of areas that included access to land suitable for dry-land farming–the alluvial areas in both the Mesilla Bolson and the Tularosa Basin around Filmore Pass. Access to the desert floor of the Tularosa Basin, where mesquite pods and grass seeds could have been gathered during the late spring and summer, would have been easy.

Mountain areas, such as Fresnal Shelter, would have been visited in late summer and early fall for the various plants that could be gathered and for hunting deer. In the late fall, basin sites could have been revisited for collecting dried mesquite pods; at the same time tornillo pods could have been collected along the river. Woodbury and Zubrow (1979) suggest maize did not become important as a staple until the Formative periods when beans were more common. Mesquite, also a legume, could have provided the same nutritional counterpart to maize.

Summary

This report has brought together information that allows us to describe land use in south-central New Mexico during the Archaic period. The study area included the Maneuver 3-8 survey, an area that consists mostly of low desert land, and in general the region can be described as expanses of this desert with intervening mountain ranges. There is a dearth of surface water in the region except for a few mountain springs and the Rio Grande, which might have been magnets for prehistoric populations. In an attempt to fill out the picture of the Archaic, excavated sites from mountains and the Rio Grande areas were discussed.

Recent assessments reveal southern New Mexico is subject to a climatic pattern that has two precipitation peaks rather than the predominantly winter rainfall of the Far West. Presently no evidence exists for dramatic changes of climate after 8000 B.C.; however, vegetation changes related to other factors probably did occur. At present we lack total agreement on the timing of the change from desert grassland to shrubland.

The Archaic period sequence, based mainly on lithic artifacts, consists of four phases–Gardner Springs, Keystone, Fresnal, and Hueco. Tool materials from the survey area were of local origin predominantly. One characteristic of the tool assemblage is the early and frequent occurrence of ground stone, a sequence that begins with mullers and milling

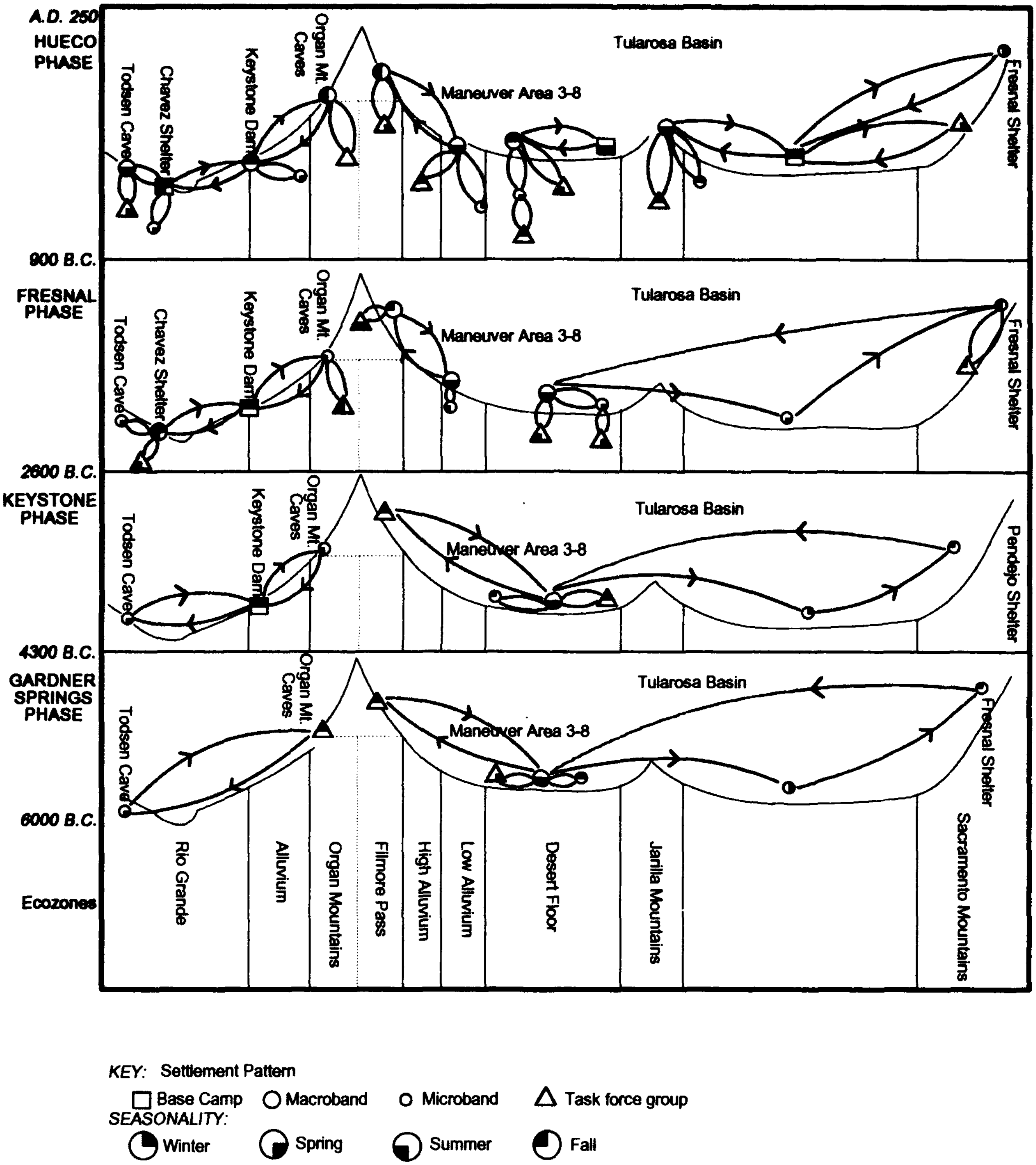


Figure III-7. Hypothetical Seasonal Scheduling Pattern of the Archaic in the Jornada Region

stones, followed by manos and metates, and then by mortars and pestles. At the end of the Archaic all of these types were being used and some of the trough metates and two-handed manos may have been used to grind corn.

The area under study was divided into desert floor, low and high alluvial, mountain, and riparian habitats. Only the desert floor and some alluvial areas received a thorough archaeological survey, and several trends seem to be indicated by these sites. One is a growing population, shown by increasing numbers of sites in both the Fresnal phase and the Hueco phase; another is an increasing dichotomy in site size. From the fairly small sites of the early phases, a pattern develops of either large or very small sites. This pattern may reflect differences in foraging strategies, or the reoccupation of sites over long periods of time. The alluvial areas show no occupation until the Fresnal phase, and the number increases in the Hueco phase. Use of alluvial areas for dry-land farming was suggested.

Although the remains of most excavated sites were not arranged according to our sequence and we have little information relevant to seasonality, we have tried to describe the settlement system of each phase. The Gardner Springs phase appears to have had a seasonally nomadic subsistence system, in which people had no base camp, but moved continually in a pattern dictated by seasonal availability of resources. The Keystone phase is similar, but one pithouse dates to the end of the phase, signaling a shift toward a system of base camps and special activity sites.

Evidence for many pithouses at the Keystone Dam site in the Fresnal phase was cited to suggest the use of base camps or multiseasonal use of the Rio Grande area at this time. Greater numbers of manos and metates, finds of maize, squash, and bean remains, and sites on alluvial slopes also suggest a changing subsistence base.

During the Hueco phase many of the larger sites in Carmichael's survey appear to be open base camps, while the use of Chavez Cave as a base camp seems likely. The number of survey sites and cave sites increased, but the great dichotomy in site size and increased use of alluvial areas are continuations of trends that began in the previous phase. Special sites for collecting mesquite pods and for jackrabbit hunting are suggested for the basin, while succulent-processing sites occur in the mountains and in the upper bajada at the North Mesa site. Visits to sites previously used to collect wild plants continued as well, and although the number of finds of maize and other domesticated plants increased, the system could be described best as an incorporation of horticulture into the seasonal round. No evidence exists of full-time agriculture or of a fully sedentary population. The combination of horticulture with visits to seasonal sites to gather resources is a trend that seems to continue into the ceramic Mesilla phase. Not until El Paso and/or Doña Ana times does village agriculture occur.

In conclusion, we can say a gradual development occurred in the Archaic from a scheduled seasonal-round pattern to a base camp or seasonal pithouse camp system. The Paleo-Indians made forays to the different ecozones in different seasons with stays at the increasingly larger base camps becoming longer and longer until very gradually they attained sedentary village life by A.D. 800 or 900. This Archaic pattern is distinctive for the Southwest, and it may be unique to the Jornada region in the American Southwest.

Section 2

Faunal Remains from Todsen Cave

Peter Dawson

To ensure a random sample of faunal material for study, numbers were assigned to each excavation unit on a map of Todsen Cave. Three units then were chosen randomly from the interior of the rockshelter behind the terminus of the dripline. A fourth unit was selected randomly from outside the rockshelter, in front of the dripline. These samples resulted in a gross bone count of 2,263 bones. For the purposes of this report, I have chosen to focus on the three units located within the cave and behind the terminus of the dripline–N0W1, S2W3, and S3W2–which contained approximately 23.7 percent of the sample.

Prior to analysis, the faunal material from each unit was sorted by stratigraphic zone, and then placed into an appropriate class: mammalian, avian, reptilian, or piscine. Analysis involved beginning at the uppermost stratum (usually zone A) and working down to the lowest represented zone. Elements of faunal remains were selected randomly for comparison with the Howard Savage Faunal Archaeo-osteology Collection at the University of Toronto, and the Department of Mammology collection located in the Royal Ontario Museum. This article is a final report on 535 bones, 514 of which (96.1 percent) were identified to order or smaller taxon.

The sample is quite well preserved, but in many cases is very fragmentary, which may be attributable to trampling. The confining dimensions of the rockshelter (18 m east-west and 4 m north-south) might result in heavy traffic that caused the trampling of any faunal material left on the occupation floor. Also, MacNeish has suggested zone D1 inhabitants were plastering wet mud, obtained from the arroyo bed, onto the floor of the shelter and "stomping" on it to construct a suitable living area, roughly from about A.D. 900 to 1300 (see Chapter IV). A cursory examination of the faunal material from unit N1W3, located in front of the dripline, further supports this idea, in that a greater number of elements appear to have been recovered whole from that unit. Nevertheless, the generally good state of the samples' preservation no doubt is attributable to the predominantly desert environment of the Southwest.

Faunal Findings

For units S3W2 and S2W3 combined, roughly 95 percent of the material analyzed was identified as mammalian, 3.3 percent as reptilian, and 1.7 percent avian (see figures III-8 and III-9). For unit N0W1, approximately 95 percent of the faunal material analyzed was identified as mammalian, 2.5 percent avian, 1.2 percent reptilian, 1.0 percent amphibian, and .25 percent fish (see Figure III-10, Table III-8). It therefore appears the faunal material recovered at Todsen is mammalian.

Table III-8. Faunal Remains by Class

All Minimum Number of Individual (MNI) counts were calculated using the frequency of *one side* of *one element* of a specific age for each species identified at Todsen. Percentages for NISP (Number of Identified Specimens) were calculated out of a total of 129 elements, and percentages for MNIs were calculated out of a total of 51 individuals for units S2W3 and S3W2. Percentages for NISP values were calculated from a total of 407 elements, and percentages for MNI values were calculated out of a total of 89 individuals for unit N0W1. MNIs were calculated separately *for each zone* in all units.

FAUNAL REMAINS BY CLASS

	Zones A-I			Zones C-M1	
	S2W3+S3W2	S2W3	S3W2	N0W1	
Mammal	123 NISP (95%)	35 MNI (68.6%)	12 MNI (25%)	386 NISP (95.1%)	78 MNI (87.6%)
Bird	2 NISP (1.5%)	1 MNI (2.0%)	0 MNI (0%)	10 NISP (2.5%)	4 MNI (4.5%)
Reptile	4 NISP (3.1%)	2 MNI (3.9%)	1 MNI (2.1%)	5 NISP (1.2%)	3 MNI (3.4%)
Amphibian				4 NISP (1.0%)	3 MNI (1.1%)
Fish				1 NISP (.25%)	1 MNI (1.1%)
Total	**129 NISP**	**38 MNI**	**13 MNI**	**406 NISP**	**89 MNI**

MAMMALIAN REMAINS

Zone		S2W3		S3W2		N0W1	
A	*Lepus sp.*	3 NISP (2.5%)	2 MNI (3.9%)	2 NISP (1.5%)	1 MNI (2.0%)		
B	*Lepus sp.*	5 NISP (4.2%)	2 MNI (3.9%)				
	N. albigula	1 NISP (0.8%)	1 MNI (2.0%)				
	L. rufus	1 NISP (0.8%)	1 MNI (2.0%)				
	O. hemonius	1 NISP (0.8%)	1 MNI (2.0%)				
	C. familiaris			1 NISP (0.8%)	1 MNI (2.0%)		
	B. taurus			1 NISP (0.8%)	1 MNI (2.0%)		
C	*Lepus sp.*	1 NISP (0.8%)	1 MNI (2.0%)				
	L. californicus					1 NISP (.25%)	1 MNI (1.1%)
D	*Lepus sp.*	9 NISP (7.5%)	2 MNI (3.9%)	1 NISP (0.8%)	1 MNI (2.0%)	19 NISP (4.5%)	3 MNI (3.4%)
	N. albigula	2 NISP (1.7%)	1 MNI (2.0%)			4 NISP (1.0%)	1 MNI (1.1%)
	C. Latrans	1 NISP (0.8%)	1 MNI (2.0%)				
	B. taurus			1 NISP (0.8%)	1 MNI (2.0%)*		
	S. auduboni					7 NISP (1.7%)	1 MNI (1.1%)
	L. californicus					11 NISP (2.7%)	2 MNI (2.2%)
	L. townsendii					1 NISP (.25%)	1 MNI (1.1%)
	Leporidae					2 NISP (.50%)	1 MNI (1.1%)
	Vulpes sp.					1 NISP (.25%)	1 MNI (1.1%)
	O. hemionus					1 NISP (.25%)	1 MNI (1.1%)
D1	*Lepus sp.*	2 NISP (1.7%)	1 MNI (2.0%)				
	O. hemionus			1 NISP (0.8%)	1 MNI (2.0%)		

** Intrusive to D*

Table III-8. continued

MAMMALIAN REMAINS, continued							
Zone		**S2W3**		**S3W2**		**NOW1**	
D2	*Lepus sp.*	13 NISP (10%)	3 MNI (5.8%)	4 NISP (3.1%)	2 MNI (3.9%)		
	Neotoma sp.	1 NISP (0.8%)	1 MNI (2.0%)				
	Rodentia	2 NISP (1.5%)	2 MNI (3.9%)				
E	*Lepus sp.*	12 NISP (9.3%)	1 MNI (2.0%)				
	C. ludovicianus	2 NISP (1.5%)	1 MNI (2.0%)				
	Vulpes sp.	1 NISP (0.8%)	1 MNI (2.0%)				
	Heteromidae			1 NISP (0.8%)	1 MNI (2.0%)		
	Lepus sp.	24 NISP (47.1%)	4 MNI (7.8%)	1 NISP (0.8%)	1 MNI (2.0%)		
	Sciuridae	1 NISP (0.8%)	1 MNI (2.0%)				
F	*C. ludovicianus*	1 NISP (0.8%)	1 MNI (2.0%)				
	C. latrans	1 NISP (0.8%)	1 MNI (2.0%)				
	Cervidae	1 NISP (0.8%)	1 MNI (2.0%)				
	Bovidae	2 NISP (1.5%)	1 MNI (2.0%)				
	Lepus sp.			1 NISP (0.8%)	1 MNI (2.0%)	13 NISP (3.2%)	2 MNI (2.2%)
	S. audoboni					14 NISP (3.4%)	3 MNI (3.4%)
	L. californicus					21 NISP (5.1%)	4 MNI (4.5%)
	L. townsendii					3 NISP (.74%)	1 MNI (1.1%)
F+	*Leporidae*					1 NISP (.25%)	1 MNI (1.1%)
	C. ludovicianus					3 NISP (.74%)	1 MNI (1.1%)
	C. latrans					1 NISP (.25%)	1 MNI (1.1%)
	Vulpes sp.					1 NISP (.25%)	1 MNI (1.1%)
	O. hemionus					1 NISP (.25%)	1 MNI (1.1%)
H	*S. auduboni*					1 NISP (.25%)	1 MNI (1.1%)
I	*Lepus sp.*			3 NISP (2.3%)	1 MNI (2.0%)		
	Rodentia			2 NISP (1.5%)	1 MNI (2.0%)		
	H. sapiens					5 NISP (12.3%)	1 MNI (1.1%)
	S. auduboni					50 NISP (12.3%)	6 MNI (6.7%)
	L. californicus					38 NISP (9.3%)	4 MNI (4.5%)
	L. townsendii					7 NISP (1.7%)	2 MNI (2.2%)
	Lepus sp.					26 NISP (6.4%)	2 MNI (2.2%)
J	*Leporidae*					1 NISP (.25%)	1 MNI (1.1%)
	C. ludovicianus					2 NISP (.50%)	1 MNI (1.1%)
	N. albigula					10 NISP (2.5%)	2 MNI (2.2%)
	D. ordii					6 NISP (1.5%)	2 MNI (2.2%)
	G. bursarius					2 NISP (.50%)	1 MNI (1.1%)
	C. latrans					2 NISP (.50%)	1 MNI (1.1%)

Table III-8. continued

MAMMALIAN REMAINS, continued							
Zone		**S2W3**		**S3W2**		**NOW1**	
J	*Vulpes sp.*					1 NISP (.25%)	1 MNI (1.1%)
	O. hemionus					1 NISP (.25%)	1 MNI (1.1%)
πJ	*H. sapiens*					4 NISP (1.0%)	1 MNI (1.1%)
	S. auduboni					19 NISP (4.7%)	4 MNI (4.5%)
	L. californicus					37 NISP (9.1%)	3 MNI (3.4%)
	L. townsendii					8 NISP (2.0%)	2 MNI (2.22%)
	Lepus sp.					20 NISP (4.9%)	3 MNI (3.4%)
	Leporidae					8 NISP (2.0%)	1 MNI (1.1%)
	C. ludovicianus					3 NISP (.74%)	1 MNI (1.1%)
	N. albigula					8 NISP (2.0%)	3 MNI (3.4%)
	C. latrans					2 NISP (.50%)	1 MNI (1.1%)
	S. auduboni					1 NISP (.25%)	1 MNI (1.1%)
K	*L. californicus*	3 NISP (2.3%)	1 MNI (2.0%)				
M1	*L. californicus*					1 NISP (.25%)	1 MNI (1.1%)
AVIAN REMAINS							
J	*Phasianidae*					2 NISP (.50%)	1 MNI (1.1%)
	Strigidae					1 NISP (.25%)	1 MNI (1.1%)
	A. flammeus					1 NISP (.25%)	1 MNI (1.1%)
πJ	*Phasianidae*					1 NISP (.25%)	1 MNI (1.1%)
REPTILIAN REMAINS							
F+	*Squamata*					1 NISP (.25%)	1 MNI (1.1%)
	Chrysemys sp.					1 NISP (25%)	1 MNI (1.1%)
πJ	*Squamata*					1 NISP (.25%)	1 MNI (1.1%)
AMPHIBIAN REMAINS							
J	*Bufonidae*					1 NISP (.25%)	1 MNI (1.1%)
	Ranidae					1 NISP (.25%)	1 MNI (1.1%)
πJ	*Ranidae*					1 NISP (.25%)	1 MNI (1.1%)

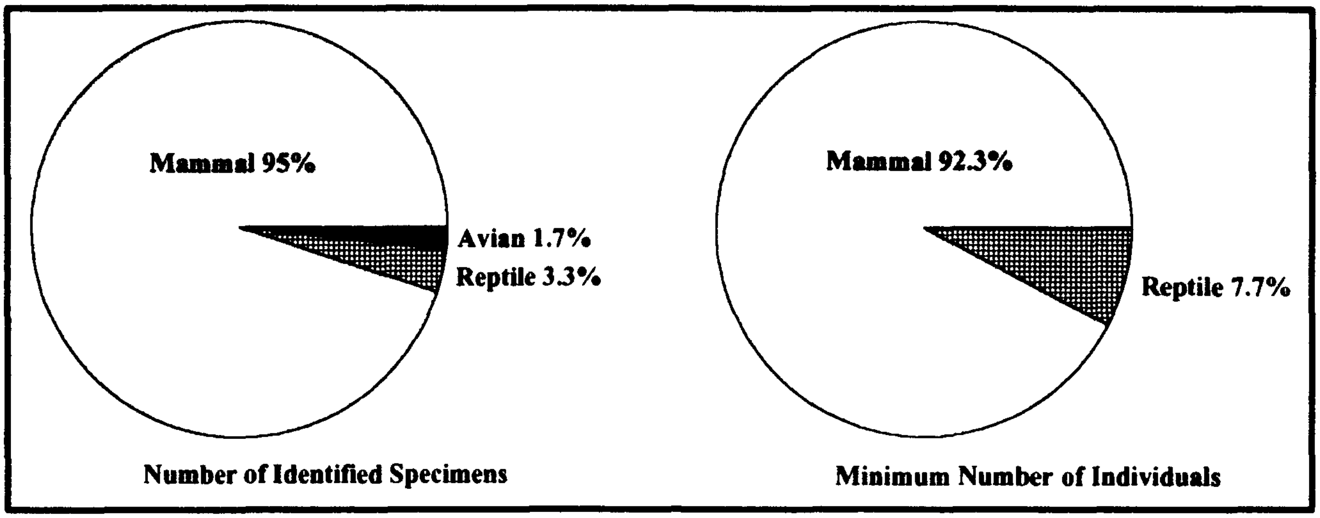


Figure III-8. Faunal Remains by Class–Unit S3W2

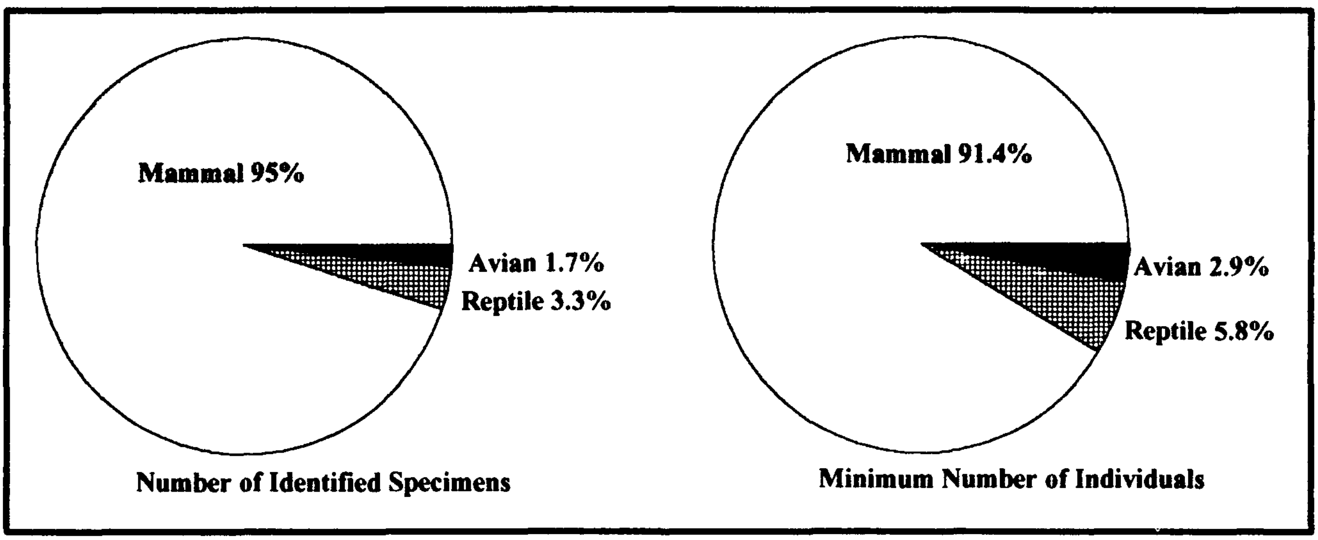


Figure III-9. Faunal Remains by Class–Unit S2W3

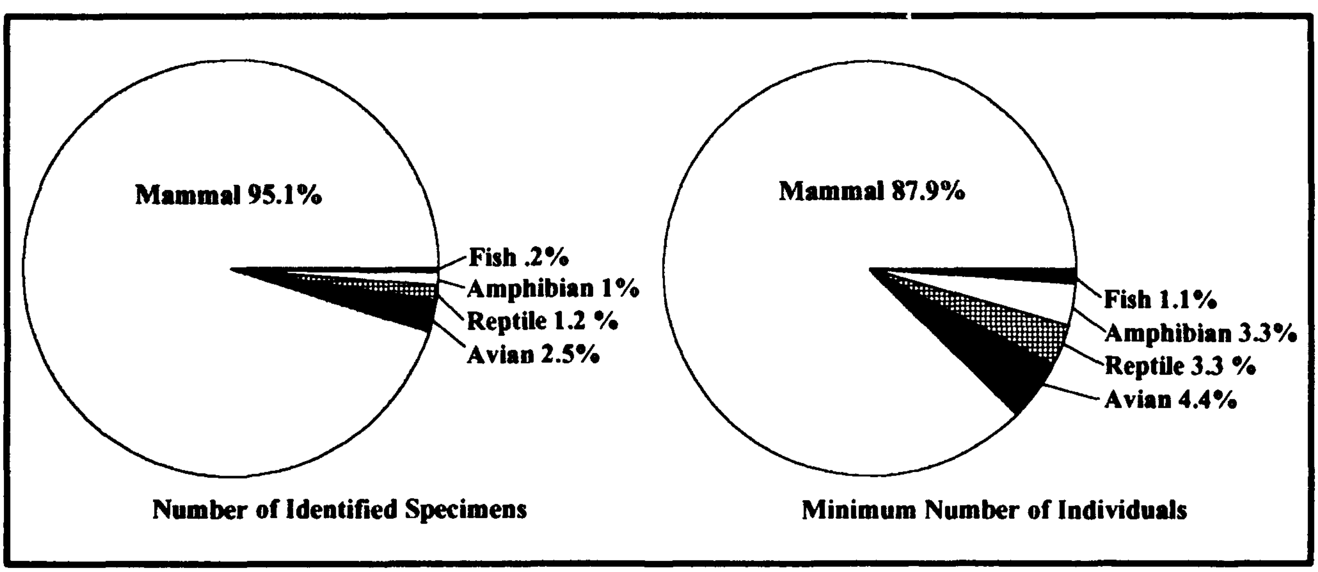


Figure III-10. Faunal Remains by Class –Unit NOW1

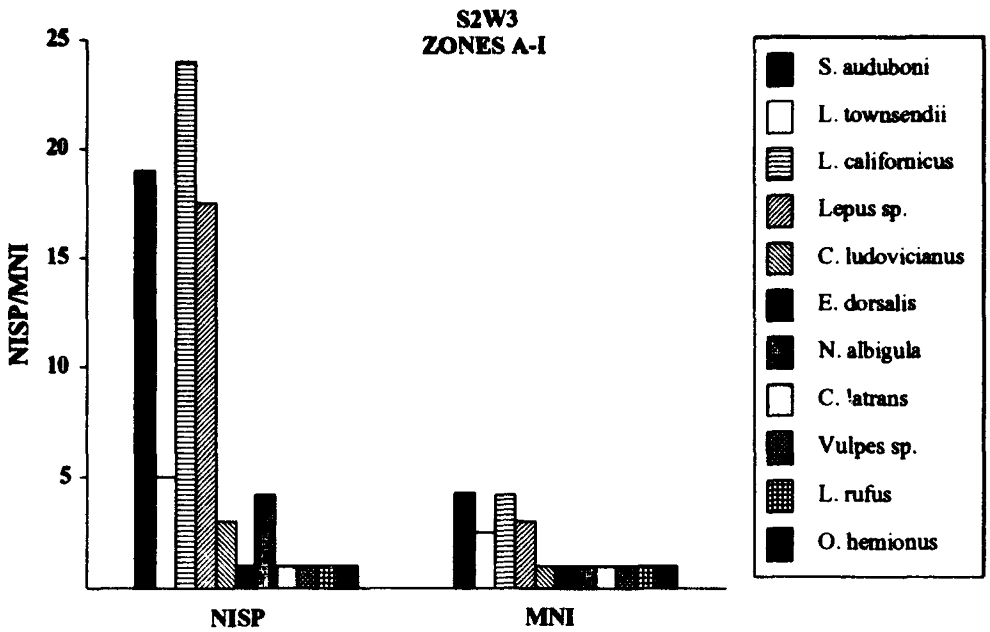


Figure III-11. Mammalian Remains by Species–Unit S2W3

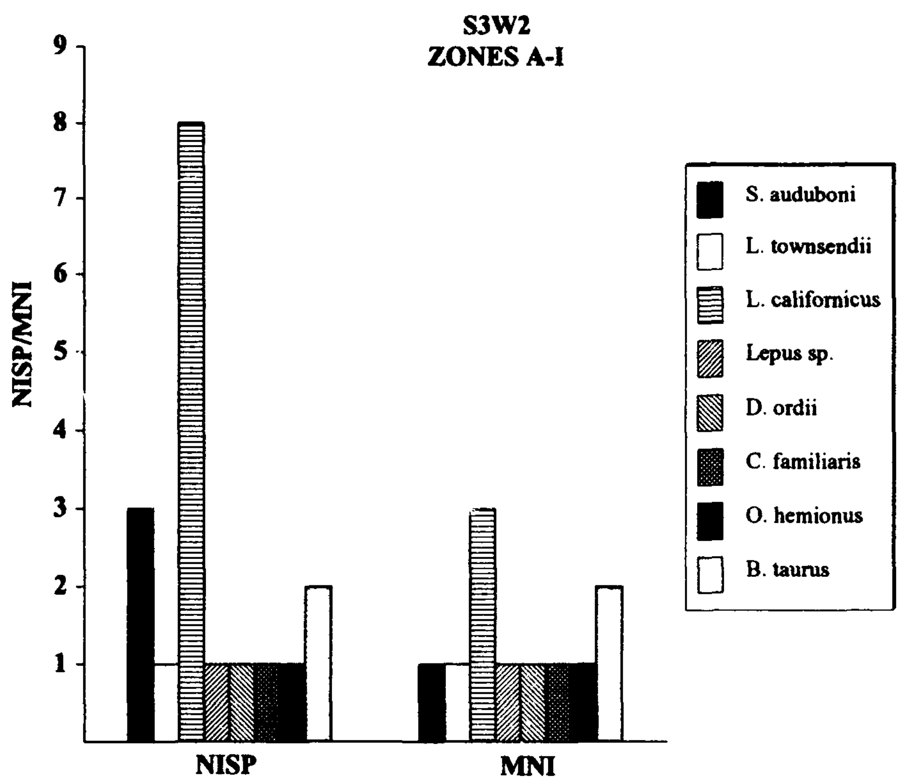


Figure III-12. Mammalian Remains by Species–Unit S3W2

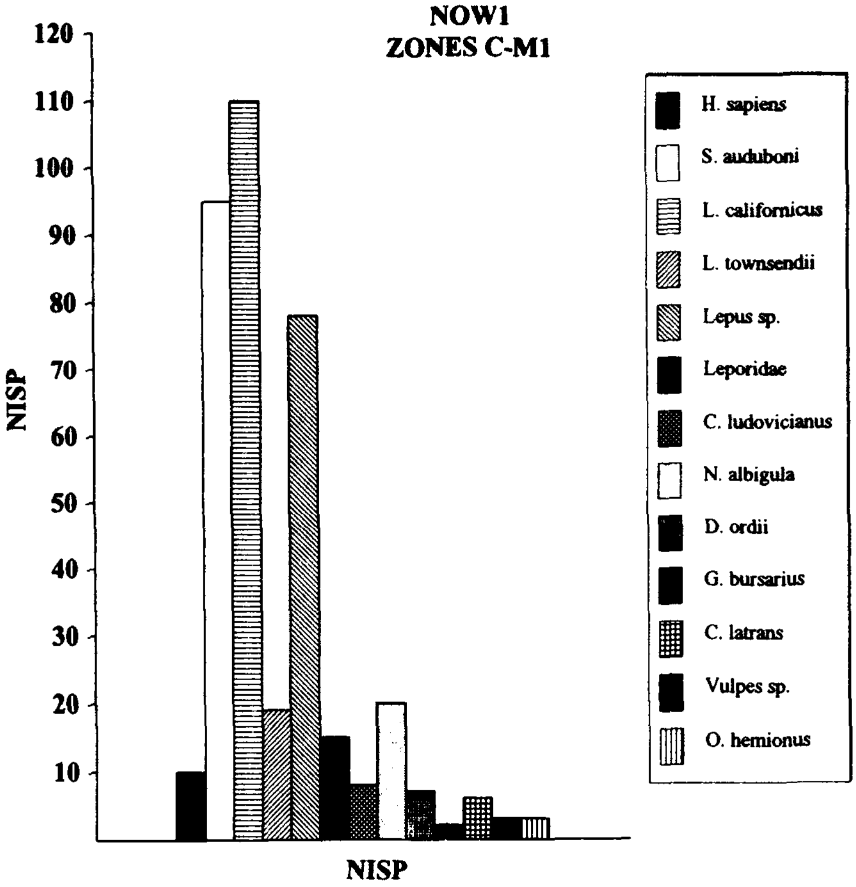


Figure III-13. Mammalian Remains by Species–Unit NOW1

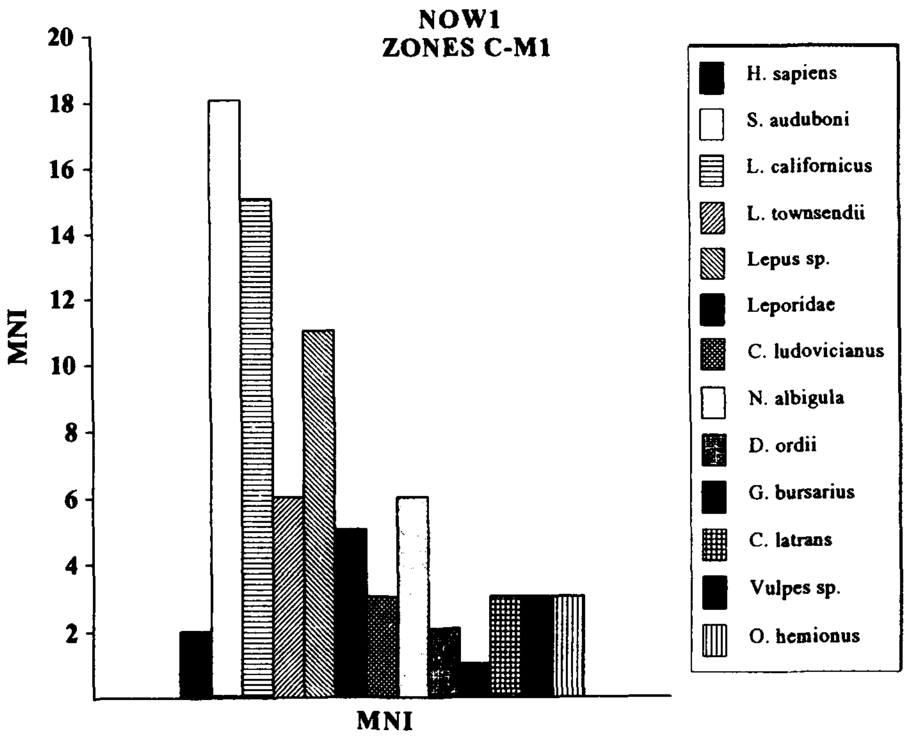


Figure III-14. Mammalian Remains by Species–Unit NOW1

Discussion of Identified Taxa

In total, 16 mammalian species have been identified at Todsen Cave thus far, and are summarized in tables III-10 and III-11 and in figures III-11 to III-14 (by distribution).

Hominidae. A total of eight elements identified as *Homo sapiens* were recovered from zones J and πJ, and likely represent the remains of one individual. Two unfused portions of thoracic vertebra indicate these remains are associated with an immature individual. This is further confirmed by measurements of a talus, and proximal radius recovered from zone J. These elements may represent a highly disturbed burial or indiscriminately deposited human remains, probably the latter.

Leporidae. The family Leporidae has by far the greatest range in distribution in both unit S2W3 and unit S3W2, representing approximately 77.6 percent of the sample under examination (see figures III-15, III-16, III-17, and III-18. Within this family, three species have been identified: *Sylvilagus auduboni* (desert cottontail rabbit), *Lepus townsendii* (white-tailed jackrabbit), and *L. californicus* (black-tailed jackrabbit). A somewhat conservative approach was used in the calculation of the MNI for each unit at Todsen Cave. All three species of rabbit have ranges that extend over large areas of New Mexico, with *S. auduboni* and *L. californicus* inhabiting southeastern and southwestern areas, respectively.

L. townsendii presently restricts its range toward the more northeastern areas of the state. However, over time, the ranges of all three species may have differed, and perhaps even overlapped because of environmental change. Also, each species most commonly is identified on the basis of soft tissue differences. Skeletal differences among these three species usually can be assessed only on the basis of size, with *L. townsendii* being the largest, and *S. auduboni* the smallest. For these reasons, MNIs were calculated at the level of family only. Using one side of the most frequently represented element of a specific age, at least 15 individuals were calculated as present in S2W3, and seven individuals for S3W2, out of a total of 78 bones attributed to Leporidae, and at least 55 individuals were calculated out of a total of 316 elements attributable to Leporidae, for unit N0W1.

S. auduboni subsists on a variety of herbaceous plants, and often will occupy abandoned prairie dog "towns," rugged gulches, and small, rocky canyons (Baily 1971). Preferring slightly more open, prairie-type habitats, *L. townsendii* also feeds on a variety of herbaceous plants, as well as the buds, bark, and twigs of many species of desert scrub (Baily 1971). *L. californicus* probably represents the most common species of Leporidae at Todsen, as it has the largest range of these three species. Its present range covers most of southwestern New Mexico, and it commonly frequents the slopes of mesas, tending to congregate in canyons similar to Spring Canyon, which can provide enough moisture to support green plants during certain seasons of the year. Population densities for this species have been assessed as high as 400 individuals per square mile. To many contemporary native peoples of the Southwest, *L. californicus* represents an important and very practical source of food (Baily 1971).

Sciuridae. The family Sciuridae is represented by the remains of at least two individuals–one from S2W3 zone E, and one from the underlying zone F. Both individuals were identified as *Cynomys ludovicianus*, or black-tailed prairie dog. This species inhabits the southern part of New Mexico, and frequents mesa tops near scattered growths of juniper and nut pine, as well as the short-grass slopes of open valleys and canyons. Well adapted to the arid conditions characteristic of many southwestern deserts, *C. ludovicianus* often will feed on cactus and mesquite bark (Baily 1971).

A third member of the family Sciuridae was identified as *Eutamias dorsalis*, or cliff chipmunk. The proximal end of a left femur, representing one individual, was recovered from zone E of S2W3. *E. dorsalis* is the largest of the New Mexico chipmunks. Its habitation is limited to rocky walls, cliffs, and canyon slopes, where it keeps in close association with junipers and nut pines (Baily 1971).

Geomyidae. Zone J of unit N0W1 produced two elements that represent at least one individual, associated with *Geomys bursarius*–the Plains pocket gopher. All members of this family are well adapted to underground living, with

short, sturdy bodies, heavily muscled legs, and large cheek pouches for transporting seeds and other forms of food (Baily 1971). Members of this species often construct extended burrows in the light, sandy soils that characterize much of southeastern New Mexico, and as a result, have the potential to disturb local archaeological resources.

Heteromyidae. A radius recovered from zone E of S3W2 has been identified as *Dipodomys ordii*, the common kangaroo rat, part of the family Heteromyidae. This element represents at least one individual. Zone J of N0W1 yielded six elements attributable to this species and represents at least two individuals. *D. ordii* is a mound-building rodent that inhabits the hard, dry soils of mesa tops and feeds on a wide variety of desert grasses and plants, as well as seeds and grains (Baily 1971).

Cricetidae. The family Cricetidae is represented by no less than seven individuals, identified as *Neotoma albigula*, more commonly known as the white-throated wood rat. A second species of wood rat, *N. micropus*, also is found in areas of southeastern New Mexico; however, these two species can be distinguished only on the basis of soft tissue differences and *micropus*'s slightly larger body size (Baily 1971). Because the range of *N. albigula* is much greater than that of *N. micropus* in and around the Spring Canyon locality, it is more likely represented at Todsen Cave. Three elements were recovered from S2W3, and indicate the presence of at least one individual from zone B, and one from zone D. Zones πJ, J, and D from N0W1 produced a total of 22 elements, indicating no less than six individuals. The range of this species covers most of the state, where rugged localities affording loose rock and fissure-riddled cliffs provide ideal homes. *N. albigula* characteristically is nocturnal, and feeds on a variety of seeds, fruits, and cactus pulps (Baily 1971).

Canidae. At least one individual present in the assemblage, and recovered from zone B of S3W2, was identified tentatively as *Canis familiaris*. A fourth premolar recovered from zone D of S2W3, however, was identified as *C. latrans*, indicating the presence of one individual in this unit. A phalanx, femur, and the distal end of a rib support *C. latrans'* presence in zone πJ in unit N0W1. Zones F+ and J in the same unit also yielded a premolar, and the proximal and distal portions of an ulna and tibia, respectively. Of these five elements recovered, no less than three individuals are represented. Because the presence of each of these two species has been established on the basis of only seven respective elements, the possibility exists that all represent *C. latrans*, which ranges over the entire state of New Mexico, adapting to a wide variety of environmental settings, and, at present, has a large population density.

From zone E in S2W3, the distal end of a tibia has been identified to the genus *Vulpes spp.*, and represents the presence of at least one individual. Zones J, D, and F+ in unit N0W1 also produced several elements identified to the genus *Vulpes spp.* These three elements indicate the presence of at least three individuals, and further support the presence of this genus at Todsen. Species of fox that inhabit New Mexico include *V. microtis* (New Mexico desert fox), *V. macrourus* (Western red fox), and *V. velox* (Kit Fox), as well as *Urocyon cinereoargenteus* (Arizona grey fox). The last species, however, is more north ranging and can be more or less excluded from consideration. In general, members of this genus occupy open mesa country, bordering canyons and valleys, and hunt a variety of prey, including jackrabbit, kangaroo rat, and desert cottontail. It is interesting to note that the range of *Vulpes spp.* in New Mexico roughly corresponds to that of the kangaroo rat–also identified at Todsen (Baily 1971).

Felidae. An atlas recovered from zone B of S2W3, identified as *Lynx rufus* (bobcat), indicates the presence of at least one individual at Todsen. Common over many areas of New Mexico, this species is most abundant on the rocky slopes of gulches and canyons, as well as in juniper and nut pine forests. *L. rufus* subsists on a varied diet of rabbits, rodents, and the occasional mule deer or mountain goat. During the month of January, in 1903, numerous bobcats were reported on the rocky slopes of the Organ Mountains by local ranchers (Baily 1971). Since the Organ Mountain range is less than 50 km from Todsen, this report tends to support the presence of *L. rufus* at the site.

Cervidae. Five elements examined thus far have been identified as *Odocoileus hemionus*, or mule deer. These include a molar tooth from zone B of S2W3, and a premolar tooth from zone D1 of S3W2, representing the presence of at least two individuals. Unit N0W1 produced a premaxilla from zone F+, and an antler bud from zone J–indicating the presence of no fewer than four individuals at Todsen. *O. hemionus* characteristically has a great vertical range, of-

ten living between 7,000 and 12,000 feet. This species is able to survive at great distances from water, and has adapted to an arid desert life by being able to derive much of the moisture it needs from the fleshy fruits of various types of cactus. Mule deer represent an important resource for many Southwestern peoples, including the Mescalero Apache, who utilize buckskin in the manufacturing of clothing (Baily 1971). The present-day range of *O. virginianus*, the Plains white-tailed deer, is far removed from the Spring Canyon locality, thereby reducing the probability of its presence in the Todsen Cave assemblage.

Bovidae. The identification of five Bovidae specimens from zone D2 and two Bovidae specimens from zone F indicates a minimum of two individuals attributable to this family in unit S2W3. Zones D and J of unit N0W1 produced one premolar and two fragmentary teeth that were identified as Bovidae, suggesting an MNI of two individuals. Two species belonging to the Bovidae family, and found inhabiting certain areas of New Mexico, are *Ovis canadensis* (mountain sheep) and *Oreamnos americanus* (mountain goat). Both species live in rocky mountain areas above the timberline and are excellent climbers. Baily (1971) reports it is unlikely *O. canadensis* occurs within the limits of New Mexico, except for certain areas of the Guadalupe and San Andres mountains. Therefore, it is likely the elements identified as Bovidae are associated more closely with mountain goat than mountain sheep. At one time, however, both species may have inhabited areas of the Organ Mountains. These animals' use of natural fissures and caves as shelters during storms has been reported, and humans may have exploited such caves as natural game traps. The possibility thus exists that Todsen inhabitants may have made infrequent subsistence quests to the Organ Mountains in search of such quarry. This speculation, however, is unsupported by data, since I have yet to identify such remains as to species. The identification of one scapula from zone B and one tooth from zone D in S3W2 indicates a minimum number of two individuals identified as *Bos taurus*, or cow. The presence of the tooth in zone B is consistent with the idea that area ranchers at one time used Todsen as a corral or natural containment area for cattle. The presence of a bovine scapula in zone D, however, suggests it is intrusive to this stratum.

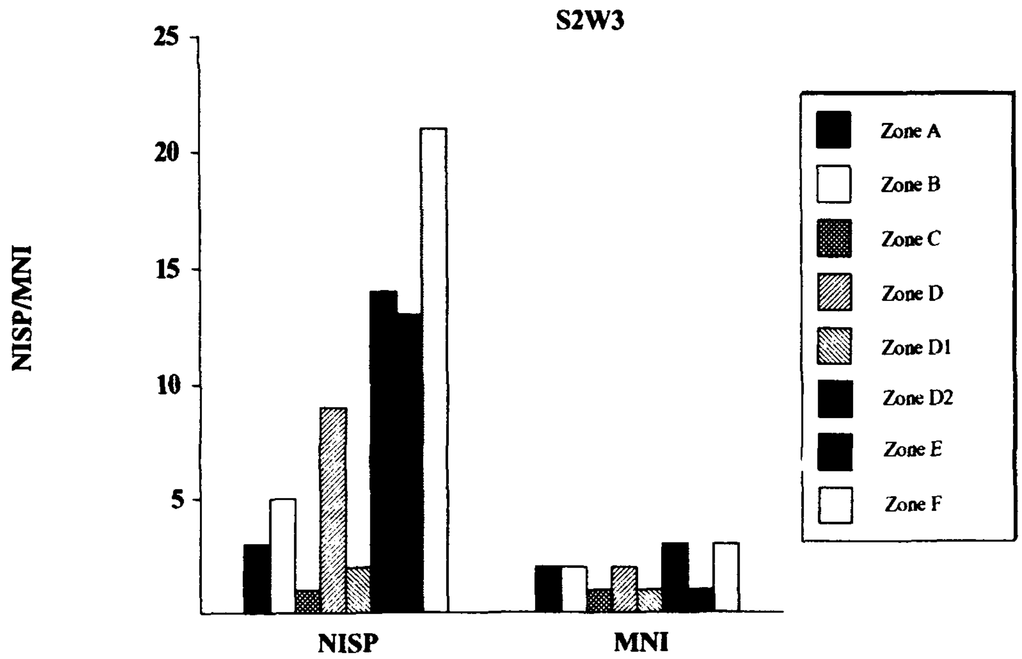


Figure III-15. Leporidae Remains–Unit S2W3

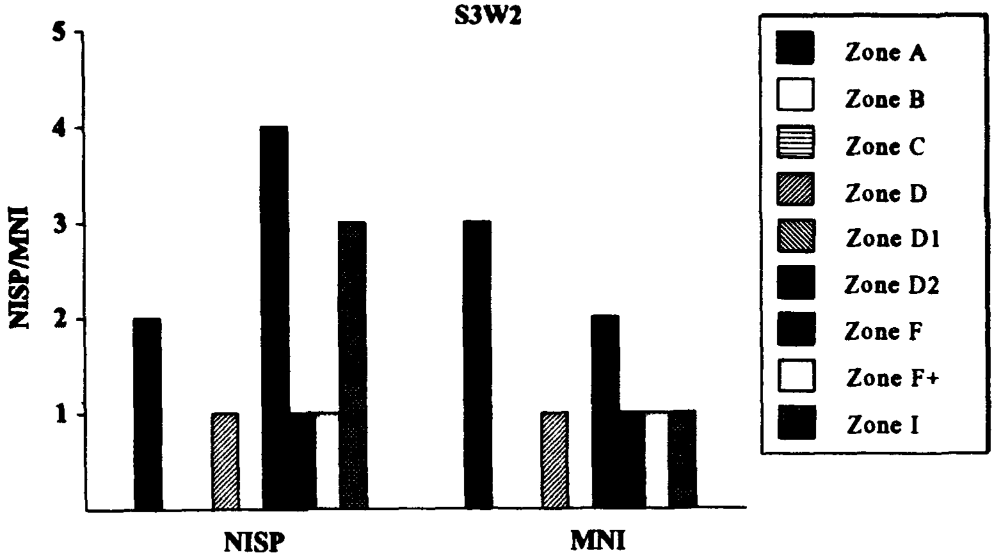


Figure III-16. Leporidae Remains–Unit S3W2

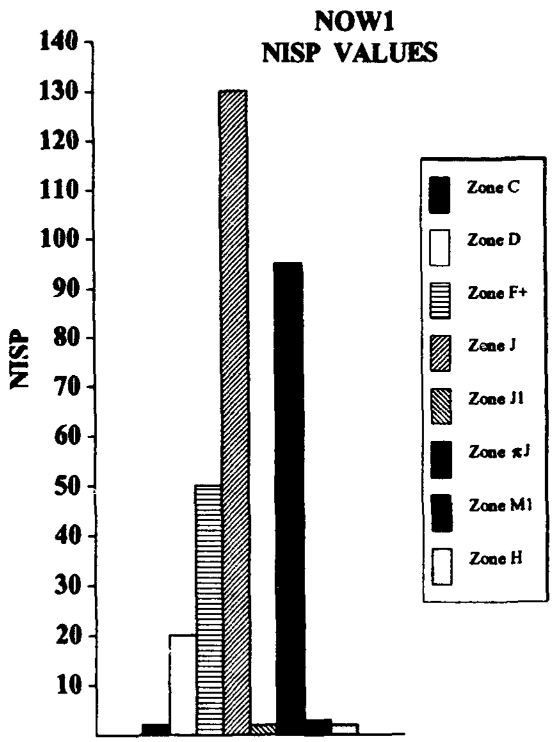


Figure III-17. Leporidae Remains–Unit N0W1, Numbers of Species

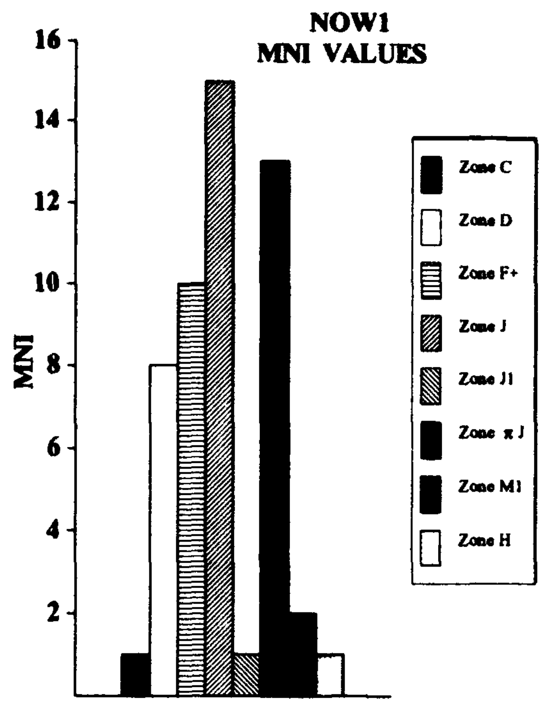


Figure III-18. Leporidae Remains–Unit N0W1, Minimum Number of Individuals

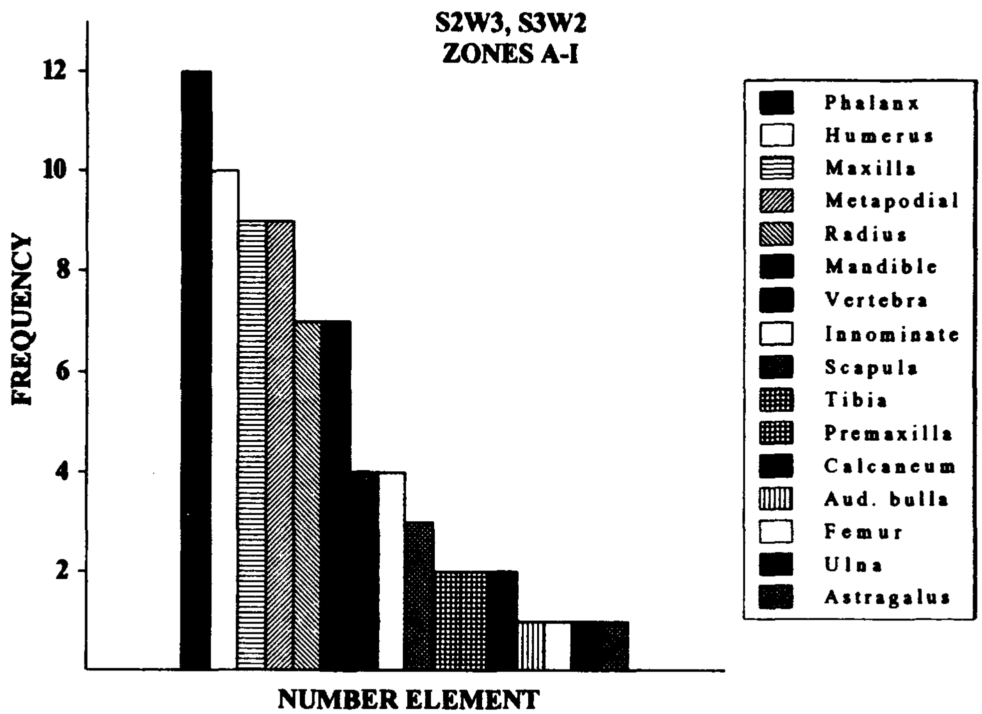


Figure III-19. Frequency of Leporidae Elements–S2W3 and S3W2

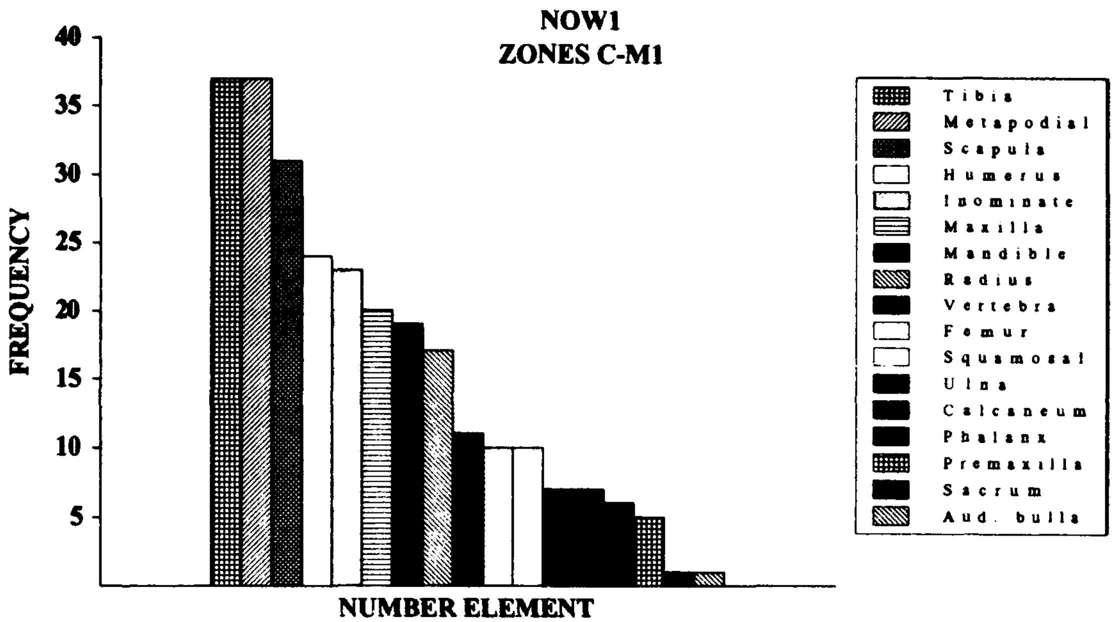


Figure III-20. Frequency of Leporidae Elements–NOW1

Avian Remains. Of the 535 elements identified to class thus far, only 2.2 percent of these can be assigned as Avian. Two elements were recovered from zone E of S2W3 and indicate the presence of at least one individual. Two elements from zone J and one element from zone πJ have been identified to the family Phasianidae, and suggest the presence of at least two individuals in unit N0W1. Phasianidae represents the largest family existing in the order Galiformes. Many species are largely ground dwelling, and subsist on a variety of seeds and shoots (Perrins and Middleton 1985). Because of their reliance on gycogen-burning sprint muscles, many members of this family can sustain flight only for brief periods of time. As a result, many species largely are nonmigratory, spending much of their lives within several kilometers of their birthplace (Perrins and Middleton 1985).

Zone J in unit N0W1 yielded four elements identified to the family Strigidae. Three of these elements were identified further down to the species *A. flammeus*–commonly known as the short-eared owl. The desert-adapted forms of the family Strigidae often are sandy colored, and subsist on a variety of rodents, birds, frogs, and fish. Often nesting in open rock fissures in canyon walls, many desert-adapted species will regulate their breeding periods with fluctuations in the rodent population (Perrins and Middleton 1985).

Specimens recovered from units S2W3 and S3W2 might be associated with several species of canyon swallow, which nest in many of the small cracks in the walls of Spring Canyon.

Reptilian Remains. Reptilian remains comprise approximately 1.7 percent of the sample examined thus far. Two vertebra from zone E of S2W3 were identified as belonging to the order Squamata, as were two other vertebrae recovered from zone F+ and πJ in unit N0W1. Several different species of snake inhabit the American Southwest, including members of the genus *Crotalus,* such as the Western diamondback *(Crotalus horridus)* and the sidewinder *(C. cerastes*). Rattlesnakes tend to frequent areas of Spring Canyon and its surrounding localities, using the rocky floor and fissure-ridden walls of the canyon for hibernation and protection from the hot sun of the dry season.

The fragmentary portion of the plastron from zone E of S2W3 has been identified as belonging to the genus *Chrysemy sp.* (painted turtle). The extensive range of such turtles, their broad habitat preference, and Todsen Cave's relatively close proximity to the Rio Grande all help to support the presence of *Chrysemy* in the assemblage.

Amphibians. Investigations of unit N0W1 revealed the presence of the families Bufonidae (toad) and Ranidae (frog) in zones J and πJ at Todsen. A portion of an innominate, identified to the family Bufonidae and recovered from

zone J, suggests the presence of at least one individual. Members of the Bufonidae family characteristically have short, heavy bodies and enlarged parotid glands, used to secrete a poisonous substance in defense against predators. Four species occur within the vicinity of Todsen Cave, and these include the Couches spadefoot, Great Plains toad, red spotted toad, and the Western spadefoot (Heymann 1975). Two tibiofibulae recovered from zones J and πJ were identified to the family Ranidae, and indicate the presence of no less than two individuals. Two species of Ranidae range over the area associated with the southeastern section of the Rio Grande floodplain–*Rana pipien*, commonly known as the leopard frog, and *R. catesbieana* or bullfrog. Both species can occupy a wide variety of habitats, ranging from forest to desert, but characteristically will stay close to associated streams or areas of marshy vegetation (Heymann 1975).

A relative absence of fish remains has been observed thus far, with only one cervical vertebra being identified from zone F+ in unit N0W1. This remain perhaps may represent the contents of a "disintegrated" owl pellet, introduced into the site by a canyon-dwelling owl. The underrepresentation of fish elements may be attributable to poor survivorship, or a recovery bias; however, more units will need to be analyzed before this, or any other cause(s), can be substantiated.

Archaeological Aspects of Faunal Findings

Food Versus Nonfood Species. In order to establish the likelihood of a particular species being utilized through time as a food source by the various inhabitants of Todsen Cave, this report uses an *ad hoc* argument based on individual meat yield. Using criteria established by White (1953) and Stewart and Stahl (1977), meat yields were calculated for all the mammalian species thus far identified at Todsen (see Table III-9).

The weights of all three species of Leporidae (rabbit) were combined and averaged out for this calculation, which indicates that up to 850 g of utilizable meat can be obtained from one individual specimen. This economical yield, combined with the high frequencies of Leporidae elements identified in the assemblage so far, support the argument that this family was used as a major food source at the site. *Sylvilagus* and *Lepus* also have been documented ethnographically as making up part of the diet of many native peoples of the Southwest, and members of these two genera seem to make up the vast majority of culturally modified bone. Technologically, the presence of projectile points at Todsen, as well as the recovery of tools, such as rabbit sticks and snares, from other sites in the Southwest, further substantiate the hypothesis that Leporidae were used as a major food source.

Another important food source, ethnographically documented among southwestern peoples, is *O. hemionus*, or mule deer. Calculations indicate that, on average, one individual can yield 47.8 kg of meat. So far, analysis has revealed only two identified specimens. However, some of the larger unidentifiable mammalian elements appear to have been fractured spirally or transversely, and may be attributable to this species, or perhaps to members of the family Bovidae. Rocky mountain goat (*O. americanus*), like mule deer, would produce a substantial meat yield of approximately 34 kg per individual; its presence at Todsen is suggested in zones F and D2 in S2W3 and zones D and J in N0W1.

C. ludovicianus, or black-tailed prairie dog, represents another possible food source at Todsen Cave. This species has the potential of providing an average yield of 420 g of utilizable meat. *N. albigula*, the wood rat, a second rodent species present at Todsen, could provide 196 g of utilizable meat. The great frequency of white-throated wood rat in and around Spring Canyon suggests it might have been an easily exploitable food source. The underrepresentation of *N. albigula* in the assemblage may be attributable to poor survivorship of individual elements, as a result of indiscriminate destruction by scavenging carnivores, or an entire suite of various site formation-site destruction processes. It is unlikely a third rodent species, *E. dorsalis* (cliff chipmunk), was utilized as a food source at Todsen. This extremely agile rodent is reported to be almost impossible to catch (Baily 1971) and provides a mere 196 g of utilizable meat.

Other mammalian, as well as reptilian, species may have been utilized as food sources at Todsen. Although there is little technological evidence to suggest the procurement of such species, the often harsh conditions associated with a desert-adapted lifestyle may have selected for more opportunistic forms of subsistence-related behavior. These species are summarized in Table III-9. The recovery of Bufonidae and Ranidae from zones J and πJ demonstrate an increase in the utilization of aquatic resources during the Hueco phase.

Table III-9. Relative Meat Yields for Possible Food-Related Species at Todsen Cave

Meat yields were calculated using criteria established by White (1953) and Stewart & Stahl (1977). Species weights were obtained from Hall & Kelson (1959), and percentage of utilizable meat values per species from White (1953). The combined and averaged weights of *Sylvilagus* and *Lepus* were used to calculate meat yields for the family Leporidae, as only minor differences exist in the amount of utilizable meat obtainable from each of the three species identified at Todsen.

Leporidae Meat Yield by Zone	
Zone	**S2W3**
A	1.7 kg x 50% x 2 MNI = 1.70 kg
B	1.7 kg x 50% x 2 MNI = 1.70 kg
C	1.7 kg x 50% x 1 MNI = 0.85 kg
D	1.7 kg x 50% x 2 MNI = 1.70 kg
D1	1.7 kg x 50% x 1 MNI = 0.85 kg
D2	1.7 kg x 50% x 3 MNI = 2.50 kg
E	1.7 kg x 50% x 1 MNI = 0.85 kg
F	1.7 kg x 50% x 3 MNI = 2.50 kg
Total	**12.65 kg**
	S3W2
A	1.7 kg x 50% x 1 MNI = 0.85 kg
D	1.7 kg x 50% x 1 MNI = 0.85 kg
D2	1.7 kg x 50% x 2 MNI = 1.70 kg
F	1.7 kg x 50% x 1 MNI = 0.85 kg
F+	1.7 kg x 50% x 1 MNI = 0.85 kg
I	1.7 kg x 50% x 1 MNI = 0.85 kg
Total	**5.75 kg**
	NOW1
C	1.7 kg x 50% x 3 MNI = 2.5 kg
D	1.7 kg x 50% x 8 MNI = 6.8 kg
F+	1.7 kg x 50% x 11 MNI = 9.3 kg
J	1.7 kg x 50% x 15 MNI = 12.7 kg
πJ	1.7 kg x 50% x 13 MNI = 11.0 kg
J4	1.7 kg x 50% x 1 MNI = 0.85 kg
M1	1.7 kg x 50% x 1 MNI = 0.85 kg
Total	**44.1 kg**

Table III-9. continued

Meat Yields of Remaining Species	
C. ludovicianus	.6 kg x 70% = .42 kg per individual
E. dorsalis	.08 kg x 70% = 59.5 g per individual
N. albigula	.28 kg x 70% = 196 g per individual
C. latrans	6.7 kg x 50% = 3.3 kg per individual
L. rufus	11.3 kg x 50% = 5.6 kg per individual

Representation of Skeletal Elements. As mentioned previously, members of the family Leporidae make up the majority of the 535 specimens identified thus far. Other species are represented, on average, by no more than ten elements. For the purposes of this report, therefore, I have chosen to focus on the representation of Leporidae skeletal elements by body portion. The frequency and type of skeletal elements identified for this family are summarized in figures III-19 and III-20.

Phalanges and the distal ends of humanerus, maxillae, and metapodials appear to have the greatest representation in units S2W3 and S3W2. Similarly, analysis of faunal material from N0W1 indicates the distal ends of tibiae, metapodials, the proximal ends of scapulae, and the distal ends of humeri have the greatest representation among the assemblages examined. Along with metapodials and radii, the distal portions of the forelimb appear to dominate much of the Leporidae assemblage. The lower extremities of limb elements characteristically yield little in the way of utilizable meat, and most likely would be discarded during butchering. The representation of various cranial elements, including portions of the premaxilla, mandible, and auditory bulla also suggests such low meat-yielding portions of the carcass may have been removed prior to cooking. The humeri analyzed appear to have been broken by transverse fractures, imparted toward the distal end of the diaphysis. It is important to note that, with the exception of the calcined Leporidae specimens, both the representation of skeletal elements, and any alterations present, also could be attributable to an entire suite of noncultural, or taphonomic, processes. These include the use of the rockshelter by various carnivores who, like their human counterparts, could introduce faunal material into the site as well as modify any surface bone abandoned on the rockshelter's floor.

The representation of mammalian and reptile elements at Todsen also may reflect the differential survivorship of the various bones of these individuals. Elements of greater density would be expected to have a higher survival rate than those of lesser densities.

Bone Alterations. Of the 535 elements identified as to class or smaller category, 37.5 percent show signs of either cultural or noncultural modification. Out of this sample, 14 percent have modifications attributable to natural agencies such as carnivore gnawing and weathering. The remaining 51 percent indicate cultural modification through calcination (heat exposure) and spiral or transverse fracturing. This latter form of modification, however, also may be attributable to natural agencies, since carnivores often produce spiral and transverse fractures by imparting static loads on bone, through the oppositional placement of canine teeth on the dyaphisis. Table III-10 lists these elements and describes their modifications.

Remarkably, 87 percent of the calcined elements are associated with the family Leporidae, indicating its members represent an important food source at Todsen. The remaining 13 percent of the calcined bone is associated with unidentifiable limb elements of medium- to large-sized mammals, many of which appear to have been fractured spirally. With the exception of a small shaft fragment of unidentified mammalian bone, and a cross-sectioned bovine scapula, a complete absence of any discernible cut marks was noted. The fragment appears to have a few negative flake scars along one edge and may have been used as an expedient scraping tool. In contrast, the scapula, identified as *B. taurus*, shows evidence of sawing, and most likely is associated with modern American use of the site.

Rodent gnawing was observed on 32 elements–a zygomatic, identified as *C. familiaris*, and a right metatarsal identified as *L. californicus*. Weathering was identified on 93 elements, and suggests these bones were present on the

surface of the site for a set length of time before being covered over. Windblown sand and the hot desert environment appear to have exfoliated the surface of these elements, producing some surface pitting as well as gradual erosions of the edges. Root etchings were observed on only six elements with grooved dendritic superficial modifications–produced by the solution of bone surfaces via dense root covering. No pathological changes were observed on any of the elements examined.

Seasonality Inference. The absence of any really concrete seasonality data from the 535 elements identified to date makes inferences regarding the seasonal occupation of Todsen Cave difficult. The fragmentary nature of the sample proved problematic with regard to aging, and because of New Mexico's characteristically warm year-round temperatures, few mammals hibernate (Baily 1971). Thus the following inferences are tentative at best.

The presence of several elements belonging to *Sylvilagus sp.* and *Lepus sp.*, including two calcined tibia, were aged as immature. One tibia, identified as *L. townsendii* and aged as sub-adult, was recovered from zone J in unit N0W1 and showed evidence of cut marks. A femur, identified to the genus *Lepus sp.* and recovered from the same zone and unit, was aged as adult and also showed evidence of cut marks. Both *Sylvilagus sp.* and *Lepus sp.* produce several litters of offspring during the course of a year, with the first set usually being born around May. Baily reports that immature individuals and sub-adults often can be found up until the end of the summer months, suggesting a spring-summer occupation for Todsen (Baily 1971). Reptilian remains identified as belonging to the order Squamata also may support this conjecture tentatively. Members of the genus *Crotalus* tend to hibernate during the winter months in New Mexico (Pope 1960). If the reptile remains are associated with *Crotalus*, a summer occupation also may be indicated.

Zoological Findings. Based on the small sample of bone examined for this preliminary report, it is difficult to ascertain accurately any environmental changes that may have occurred at the Spring Canyon locality over the last 8,000 years. Local studies conducted by Horowitz, Gerald, and Chaiffetz in 1981 suggest vegetation has changed little since the end of the Pleistocene. *Sylvilagus sp.* and *Lepus sp.* are found consistently throughout all zones at Todsen, and suggest the presence of a stable, upper bajada ecozone environment, consisting of sumac, mesquite, and large numbers of fourwing saltbush, yucca, opuntia, whitethorn acacia, and a variety of grasses.

Conclusions

A total of 535 elements have been identified to family or lower from the assemblage composed of material excavated during the 1987 field season at Todsen Cave (see Table III-11). Preliminary faunal research indicates a subsistence focus on small mammalian game, specifically of the genus *Sylvilagus sp.* and *Lepus sp.*, and tentatively supports a spring-summer occupation for the rockshelter.

Table III-10. Cultural and Noncultural Bone Alteration

HEAT EXPOSED			
SQUARE	**ZONE**	**SPECIES**	**ELEMENT**
NOW1	πJ	*S. auduboni*	Humerus (2)
		L. californicus	Calcaneum
		L. californicus	Humerus
		L. californicus	Mandible
		L. californicus	Metacarpal.3
		L. californicus	Metatarsal.3
		L. californicus	Premaxilla

Table III-10. continued

HEAT EXPOSED, continued			
SQUARE	**ZONE**	**SPECIES**	**ELEMENT**
NOW1	πJ	*L. californicus*	Tibia
		L. californicus	Tibia/Fibula
		Lepus sp.	Radius
		Lepus sp.	Tibia
		Leporidae	Metacarpal
		Canidae	Phalanx
NOW1	F+	*S. auduboni*	Femur
		S. auduboni	Tibia/Fibula
		L. californicus	Humerus
		L. californicus	Premaxilla
		L. californicus	Radius
		L. californicus	Femur
		Lepus sp.	Metatarsal
		Lepus sp.	Radius (2)
		Lepus sp.	Phalanx
		Lepus sp.	Scapula
		Lepus sp.	Zygomatic
		C. ludovicianus	Inominate
		L. townsendii	Zygomatic
NOW1	J	*S. auduboni*	Ilium
		S. auduboni	Tibia (2)
		L. californicus	Calcaneum
NOW1	D	*L. californicus*	Calcaneum
		Lepus sp.	Humerus (2)
S2W3	B	*Mammalia*	Unidentified
		L. townsendii	Phalanx.3
S2W3	D	*L. californicus*	Metacarpal
		Lepus sp.	Phalanx
S2W3	D1	*Mammalia*	Limb (Unidentified)
S2W3	D2	*Lepus sp.*	Scapula
S2S3	E	*L. californicus*	Phalanx
		Lepus sp.	Maxilla
		Lepus sp.	Radius
S2W3	F	*S. auduboni*	Humerus
		S. auduboni	Tibia (2)
		L. californicus	Zygomatic

Table III-10. continued

HEAT EXPOSED, continued			
SQUARE	**ZONE**	**SPECIES**	**ELEMENT**
S2W3	F	*Lepus sp.*	Radius
		C. latrans	Zygomatic
HEAT EXPOSED AND RODENT GNAWED			
NOW1	πJ	*S. auduboni*	Tibia
		L. townsendii	Humerus
		L. townsendii	Radius
		Lepus sp.	Ilium
		C. latrans	Rib.4
		L. californicus	Femur
		Canidae	Metapodial
NOW1	J	*Phasianidae*	Tibia
CALCINED			
NOW1	πJ	*L. californicus*	Mandible
WEATHERED			
NOW1	J	Unidentified	Vert.-T (2)
NOW1	πJ	Unidentified	Ilium
		S. auduboni	Humerus
		S. auduboni	Metatarsal.5
		S. auduboni	Scapula
		S. auduboni	Tibia
		L. townsendii	Ilium
		L. townsendii	Mandible
		L. californicus	Calcaneum
		L. californicus	Ischium
		L. californicus	Mandible (3)
		L. californicus	Scapula (2)
		L. californicus	Tibia
		L. californicus	Ulna
		Lepus sp.	Ischium
		Lepus sp.	Mandible
		Lepus sp.	Maxilla
		Lepus sp.	Radius
		Lepus sp.	Scapula
		Lepus sp.	Tibia
		Lepus sp.	Ulna
		Leporidae	Calcaneum

Table III-10. continued

WEATHERED, continued			
SQUARE	**ZONE**	**SPECIES**	**ELEMENT**
NOW1	πJ	*Leporidae*	Mandible
		N. albigula	Inominate
		N. albigula	Mandible
		C. latrans	Femur
NOW1	C	*L. californicus*	Metacarpal.3
NOW1	D	*L. californicus*	Metatarsal.3
		Lepus sp.	Metapodial
		Bovidae	Tooth
NOW1	F+	*S. auduboni*	Ischium (2)
		S. auduboni	Radius
		S. auduboni	Scapula
		L. californicus	Calcaneum
		L. californicus	Humerus
		L. californicus	Inominate
		L. californicus	Mandible (2)
		L. californicus	Metatarsal.3
		C. ludovicianus	Humerus
NOW1	J	Unidentified	Radius
		Unidentified	Talus
		S. auduboni	Femur
		S. auduboni	Ilium
		S. auduboni	Inominate
		S. auduboni	Ischium
		S. auduboni	Scapula (3)
		L. townsendii	Ilium
		L. californicus	Calcaneum
		L. californicus	Femur (2)
		L. californicus	Metacarpal.3
		L. californicus	Metapodial
		L. californicus	Metatarsal
		L. californicus	Rib.6
		L. californicus	Tibia
		Lepus sp.	Phalanx
		Lepus sp.	Vert.-L
		N. albigula	Mandible
		C. latrans	Ulna

Table III-10. continued

SQUARE	ZONE	SPECIES	ELEMENT
WEATHERD, continued			
NOW1	J	*O. hemionus*	Antler Bud
		Phasianidae	T.Metatarsus
NOW1	M1	*L. californicus*	Ulna
NOW1	πJ	*L. californicus*	Maxilla
		C. ludovicianus	Tibia
NOW1	D	*L. townsendii*	Metatarsal
		L. californicus	Humerus
		L. californicus	Metatarsal.3
		L. californicus	Premaxilla
		L. californicus	Scapula
		Lepus sp.	Humerus
NOW1	F+	*S. auduboni*	Calcaneum
		S. auduboni	Ilium
		S. auduboni	Mandible
		L. californicus	Humerus
		Lepus sp.	Metatarsal.3
		Vulpes sp.	Ulna
S2W3	A	*L. californicus*	Humerus
S2W3	D2	*S. auduboni*	Radius
		Bovidae	Vert.-T
S2W3	E	*Lepus sp.*	Metacarpal.3
		Vulpes sp.	Tibia
S2W3	F	*L. californicus*	Metarsal
		Bovidae	Scapula
S2W3	K	*L. californicus*	Metacarpal
		L. californicus	Metatarsal.3
ROOT ETCHED			
NOW1	πJ	*L. townsendii*	Humerus
		C. ludovicianus	Femur
NOW1	J	*?*	Femur
		?	Humerus
NOW1	M1	*Lepus sp.*	Humerus
NOW1	πJ	*L. californicus*	Humerus
RODENT GNAWED			
NOW1	πJ	*S. auduboni*	Femur
		S. auduboni	Humerus

Table III-10. continued

RODENT GNAWED, continued			
SQUARE	**ZONE**	**SPECIES**	**ELEMENT**
NOW1	πJ	*S. auduboni*	Tibia/Fibula
		L. californicus	Metatarsal.3
		L. californicus	Rib.5
		Lepus sp.	Vert.-L
NOW1	F+	*Leporidae*	Radius
NOW1	J	*S. auduboni*	Humerus
		S. auduboni	Metatarsal.2 (3)
		S. auduboni	Metatarsal.4
		S. auduboni	Tibia
		L. townsendii	Metatarsal.2
		L. townsendii	Tibia (2)
		L. californicus	Femur
		L. californicus	Humerus
		L. californicus	Mandible
		L. californicus	Tibia
		Lepus sp.	Metatarsal.4
		N. albigula	Femur
		Vulpes sp.	Radius
NOW1	D	*Lepus sp.*	Rib

Table III-11. Catalogue of Bones Studied

KEY:

R# = Record No.
R = Record
CN = Catalogue No.
PR = Provenience
Z = Zone

L = Level
E = Element
P = Portion
S = Side

A = Age
CM = Cultural Modification
NM = Natural Modification
C = Comments

Element:

A = Atlas
AB = Aud. Bulla
ANB = Antler Bud
AST = Astragalus
BO = B. Occipital
C = Calcaneum
CAN = Canine
CO = Coracoid
CP = Carpometacar
F = Femur
FB = Fibula
H = Humerus
I = Ilium
IN = Innominate
INC = Incisor
IS = Ischium
L(UN) = Limb (unidentified)

M = Maxilla
MC = Metacarpal
MN = Mandible
MNF = Mandible Fossa.
MO = Molar
MP = Metapodial
MS = Mastoid
MT = Metatarsal
OS = Orb. Spenoid
PH = Phalanx
PL = Plastron
PM = Premaxilla
PPM = Pal. Pro-Max
PRM = Premolar
R = Radius
RB = Rib
S = Scapula

SQ = Squamosal
ST = Sternal
T = Tibia
TA = Talus
TB = Tibiofibula
TM = Temporal
TMT = T. Metatarsus
TR = Tarsometatar
TTH = Tooth
U = Ulna
UN = Unidentified
UPMO.1 = Upper Molar #1
V = Vertebra
V-C = Vert.-C
V-L = Vert.-L
V-SAC = Vert.-Sacral
V-T = Vert.-T

Z = Zygomatic

Portion:

CZ = Complete Zygomatic
D = Distal
DE = Distal Epiph.
DO = Dorsal
F = Fragment
M = Molar

P = Proximal
PC = Proximal/Complete
PE = Proximal Epiph.
PED = Proximal End
R/C = RT & Cusp.
S = Shaft

SB = Sup. Border
T/R = T & Root
V = Vent
Z = Zygomatic
ZP = Zygomatic Proximal

Comments:

C = Calcined
CM = Cut Mark
CMD = Cultural Modification
CW = Cusp Worn
F = Fragmentary

G = Gnawing RE = Root Etching
HE = Heat Exposed
JC = Juvenile Cortex
M = Middle
P = Polish

RG = Rodent Gnaw
SF = Spiral Fracture
T = Teeth
W = Weathered

[illegible]	B	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	COM
1													
2	469	12734	NOW1	J	14	*H. sapiens*	V-T	25%		IMA		Y	W
3	470	11510			14	*H. sapiens*	V-T	25%		IMA		Y	W
4	403	11101			11	*Lepus sp.*	SQ	100%	L	IM+			
5	424	12944	NOW1	πJ	8	*H. sapiens*	I	20%	L	IM+		Y	W
6	531	11104			11	*H. sapiens*	MT	100%	I	IMA			
7	449	10634			0	*H. sapiens*	P.2	100%		IM+			
8	448	10634			0	*H. sapiens*	P.2	100%		IM+			M
9	489	10048			7	*S. auduboni*	F	D20%		IM+		Y	RG
10	468	9228			9	*S. auduboni*	H	D10%	L	IM+	Y		HE
11	431	9912			0	*S. auduboni*	H	D10%	R	IM+			
12	471	9705			5	*S. auduboni*	H	D20%	L	IM+		Y	W
13	430	9912			0	*S. auduboni*	H	D20%	L	IM+			
14	511	10751			10	*S. auduboni*	H	D30%	L	IM+			
15	467	9728			9	*S. auduboni*	H	D40%	R	IM+	Y		HE
16	442	10440			0	*S. auduboni*	H	D60%	R	IM+		Y	RG
17	494	10455			8	*S. auduboni*	IN	90%	R	IM+		Y	W/RG
18	414	9891			11	*S. auduboni*	M	100%	L	IM+			
19	445	10440			0	*S. auduboni*	MT	100%	L	IM+			
20	479	9892			6	*S. auduboni*	MT.5	100%	R	IM+		Y	W
21	499	10664			8	*S. auduboni*	R	100%	R	ADU			
22	432	9912			0	*S. auduboni*	SC	D20%	L	IM+			
23	473	9708			5	*S. auduboni*	SC	P20%	R	IM+		Y	W
24	460	11127			9	*S. auduboni*	SQ	100%	L	IM+			
25	498	10457			8	*S. auduboni*	T	D50%	L	IM+		Y	W
26	519	10459			8	*S. auduboni*	T	S70%	L	IM+	Y	Y	HE/RG
27	488	10048			7	*S. auduboni*	T/FB	S20%	L	IM+		Y	RG

Table III-11. continued

R#	R	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
28	500	10605	NOW1	πJ	9	*S. auduboni*	U	100%	R	ADU			
29	512	10754			0	*L. townsendii*	H	D40%	L	IM+		Y	RE
30	508	10751			10	*L. townsendii*	H	P40%	L	ADU	Y	Y	HE/RG
31	506	10662			9	*L. townsendii*	I	100%	L	IM+		Y	W
32	491	10047			7	*L. townsendii*	MN	P25%	L	IM+		Y	W
33	429	9912			0	*L. townsendii*	M	CZ	R	IM+		Y	
34	509	10751			10	*L. townsendii*	R	100%	L	IM+	Y	Y	HE/RG
35	495	10464			8	*L. townsendii*	ST.4	100%		IM+			
36	530	14896			10	*L. townsendii*	V-C	100%		IM+			
37	440	10440			0	*L. californicus*	AB	100%	L	IM+			
38	433	9912			0	*L. californicus*	C	100%	L	IM+		Y	W
39	480	9866			6	*L. californicus*	C	100%	R	IM+	Y		HE
40	422	9913			6	*L. californicus*	F	D25%	R	IMA	Y	Y	HE/RG
41	416	10750			10	*L. californicus*	F	P15%	L	IM+			
42	533	10139			7	*L. californicus*	H	D20%	R	IM+	Y		HE
43	503	10666			9	*L. californicus*	H	D25%	R	IM+			
44	437	9912			0	*L. californicus*	IS	100%	R	IM+		Y	W
45	435	9912			0	*L. californicus*	MN	20%	L	IM+		Y	W
46	472	9710			5	*L. californicus*	MN	40%	R	IM+		Y	W
47	438	10440			0	*L. californicus*	MN	50%	L	IM+	Y		C
48	481	10052			7	*L. californicus*	MN	80%	L	IM+		Y	W
49	490	10048			7	*L. californicus*	MN	P20%	R	IM+	Y		HE
50	505	10654			9	*L. californicus*	MN	P25%	R	IM+			
51	428	9910			6	*L. californicus*	M	30%	R	IM+			
52	507	10663			9	*L. californicus*	M	CZ	R	IM+			
53	501	10660			9	*L. californicus*	M	CZ		IM+			
54	451	10634			9	*L. californicus*	M	CZ	L	IM+			
55	425	9899			6	*L. californicus*	M	100%	L	IM+			
56	477	9709			5	*L. californicus*	MC.3	100%	R	IM+	Y		HE
57	523	9880			6	*L. californicus*	MT.3	100%	L	IM+		Y	RG
58	534	10139			7	*L. californicus*	MT.3	P60%	R	IM+	Y		HE
59	524	9890			6	*L. californicus*	PRM	100%	L	IM+	Y		HE
60	450	10634			9	*L. californicus*	R	P15%	R	IM+			
61	461	11127			9	*L. californicus*	RB.5	P25%	L	IM+		Y	RG
62	443	10440			0	*L. californicus*	S	P15%	L	IM+			
63	532	10139			7	*L. californicus*	S	P15%	L	IM+		Y	W
64	418	10750			10	*L. californicus*	S	P15%	R	IM+		Y	W

Table III-11. continued

ID#	R	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
65	458	11127	NOW1	πJ	9	*L. californicus*	SQ	100%	L	IM+			
66	526	10458			8	*L. californicus*	SQ	100%	R	IM+			
67	497	10463			8	*L. californicus*	T	D15%	R	IM+		Y	W
68	439	10440			0	*L. californicus*	T	S40%	R	IM+	Y		HE
69	517	9704			5	*L. californicus*	T/FB	S25%	R	IM+	Y		HE
70	483	10048			7	*L. californicus*	U	P25%	R	IMA		Y	W
71	423	9911			6	*Lepus sp.*	I	50%	R	IMA	Y	Y	HE/RG
72	427	11126			11	*Lepus sp.*	IS	70%	L	IM+		Y	W
73	476	9729			5	*Lepus sp.*	MN	15%	L	IM+		Y	W
74	434	9912			0	*Lepus sp.*	MN	20%	L	IM+			
75	457	11127			9	*Lepus sp.*	MN	20%	R	IM+			
76	492	10143			7	*Lepus sp.*	M	CZ	L	IM+		Y	W
77	441	10440			0	*Lepus sp.*	M	Z60%	L	IM+			
78	436	9912			0	*Lepus sp.*	PPM	100%	R	IM+			
79	516	9708			5	*Lepus sp.*	R	D15%	R	ADU		Y	W
80	446	10440			0	*Lepus sp.*	R	S50%	L	IM+	Y		HE
81	417	10750			10	*Lepus sp.*	S	15%	L	IM+			
82	426	9878			6	*Lepus sp.*	S	P10%	L	IM+			
83	504	10654			9	*Lepus sp.*	S	P20%	L	IM+		Y	W
84	464	11127			9	*L. californicus*	SQ	100%	L	IM+			
85	486	10048			7	*Lepus sp.*	SQ	100%	R	IMA			
86	420	9867			6	*Lepus sp.*	T	DE	R	IMA	Y		HE
87	485	10048			7	*Lepus sp.*	T	D15%		IM+			JC
88	419	10750			10	*Lepus sp.*	T	S20%		IM+		Y	RG/W
89	515	9889			6	*Lepus sp.*	T	S80%		IM+		Y	W
90	484	10048			7	*Lepus sp.*	U	P20%	R	IM+		Y	W
91	502	10659			9	*Lepus sp.*	V-L	90%		IM+		Y	RG
92	452	10634			9	*Leporidae*	C	100%	R	IM+		Y	W
93	475	9728			5	*Leporidae*	MN	15%	R	IM+		Y	W
94	474	9728			5	*Leporidae*	M	100%	R	IM+			
95	478	9912			5	*Leporidae*	MC	100%	R	IM+		Y	HE
96	462	11127			9	*Leporidae*	PH	100%		IM+			
97	455	11127			9	*Leporidae*	TM	100%	L	IM+			
98	456	11127			9	*Leporidae*	TM	100%	R	IM+			
99	463	11127			9	*Leporidae*	U	P50%	L	IM+			
100	466	9728			9	*Sciuridae*	MN	90%	R	IM+			
101	496	10464			8	*C. ludovicianus*	F	P85%	R	IM+		Y	RE

Table III-11. continued

B#	R	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
102	465	9728	NOW1	πJ	9	*C. ludovicianus*	MN	90%	R	IM+			
103	453	10634			9	*N. albigula*	I	100%	L	IM+			
104	454	11127			9	*N. albigula*	I	100%	R	IM+			
105	518	9781			6	*N. albigula*	IN	40%	L	IM+		Y	W
106	535	10139			7	*N. albigula*	MN	60%	R	IM+		Y	W
107	527	9897			6	*N. albigula*	MN	100%	R	IM+			
108	482	10048			7	*N. albigula*	MN	100%	R	IM+			
109	493	10462			7	*N. albigula*	R	100%	L	IM+			
110	459	11127			9	*N. albigula*	T	P25%	L	IM+			
111	421	9897			6	*Canidae*	MP	100%		IM+	Y	Y	HE/RG
112	487	10048			7	*Canidae*	PH	P80%		IM+	Y		HE
113	521	12943			10	*C. latrans*	F	S40%	R	IM+		Y	W
114	520	10656			9	*C. latrans*	RB.4	100%	L	IM+	Y	Y	HE/RG
115	447	10440			0	*Squamata*	V	100%		IM+			
116	444	10440			0	*Phasianidae*	TR	100%	L	IM+			
117	522	10053			7	*Ranidae*	TB	S60%		IM+			
118	156	8878	NOW1	C	7	*L. californicus*	MC.3	100%	L	IM+		Y	W
119	183	9138	NOW1	D	5	*S. auduboni*	F	D15%	R	IM+			
120	144	11144			2	*S. auduboni*	S	D40%	L	IM+			
121	178	9112			5	*N. albigula*	T	D40%	R	IM+			
122	132	9377			4	*L. californicus*	MT.3	95%	R	IM+		Y	W
123	158	9980			7	*L. californicus*	SQ	100%	L	IM+			
124	163	9732			6	*L. californicus*	T	P20%	L	IMA			
125	180	9371			5	*Lepus sp.*	BO	75%		IM+			
126	169	9112			3	*Lepus sp.*	I	80%	L	IM+			
127	161	9732			6	*Lepus sp.*	MS	100%	R	IM+			
128	384	9140			3	*Lepus sp.*	M	100%	L	IM+			
129	188	9138			5	*Lepus sp.*	MP	D20%		IM+		Y	W
130	177	9112			5	*Lepus sp.*	MP	D50%		IM+			
131	143	9146			3	*Lepus sp.*	P	100%		IM+			
132	152	9735			6	*Leporidae*	T	D80%		IM+			
133	145	11144			2	*Leporidae*	V-L	50%		IM+			
134	185	9138			5	*Sciuridae*	S	D20%	L	IM+			
135	154	9145			3	*N. albigula*	IN	50%	L	IMA			
136	160	9732			6	*N. albigula*	MN	70%	R	IM+			
137	187	9138			5	*Vulpes sp.*	PRM	70%		IM+			
138	139	9145			3	*O. hemionus*	MO.3	50%	L	IM+			

Table III-11. continued

B#	R	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
139	159	9732	NOW1	F+	7	*Bovidae*	TTH	15%		IM+		Y	W
140	155	9986			7	*Amphibian*	UN	S		IM+			
141	253	9334			3	*S. auduboni*	F	P20%	R	IM+	Y		HE
142	209	9516			4	*S. auduboni*	H	D30%	L	IM+			
143	206	9477			4	*S. auduboni*	H	P15%	L	IM+			
144	219	9			2	*S. auduboni*	I	100%	R	ADU			
145	197	9490			4	*S. auduboni*	IS	100%	R	IM+		Y	W
146	252	9339			3	*S. auduboni*	IS	100%	R	IM+			
147	198	9489			4	*S. auduboni*	IS	100%	R	IM+		Y	W
148	212	9512			4	*S. auduboni*	MT	P95%	L	IM+			
149	246	9341			3	*S. auduboni*	PH	100%		IM+			
150	211	9488			4	*S. auduboni*	R	D20%	R	ADU		Y	W
151	193	9477			1	*S. auduboni*	S	P40%	R	IMA		Y	W
152	224	9234			2	*S. audubonni*	T	D40%	L	IMA			
153	202	9504			4	*S. auduboni*	T/FB	P25%	R	IM+	Y		HE
154	226	9231			2	*S. auduboni*	U	P20%	L	ADU			
155	249	9347			3	*L. townsendii*	Z	100%	R	IM+			
156	242	9350			3	*L. californicus*	C	100%	L	IM+		Y	W
157	201	9504			4	*L. californicus*	H	D10%	L	IMA	Y		HE
158	251	9343			3	*L. californicus*	H	D20%	L	IM+		Y	W
159	216	9216			2	*L. californicus*	H	P30%	L	ADU			
160	218	9216			2	*L. californicus*	IN	25%	L	ADU		Y	W
161	247	9351			3	*L. californicus*	MN	70%	R	IM+		Y	W
162	215	9216			2	*L. californicus*	MN	80%	L	IM+			
163	208	9514			4	*L. californicus*	MN	90%	L	IM+		Y	W
164	205	9477			4	*L. californicus*	MT.3	P90%	L	IM+		Y	W
165	243	9345			3	*L. californicus*	MT.5	100%	L	IM+			
166	259	9334			3	*L. californicus*	PM	100%		IM+			
167	200	9504			4	*L. californicus*	PM	100%	R	IM+	Y		HE
168	221	9216			2	*L. californicus*	R	P15%	R	IM+	Y		HE
169	195	9504			1	*L. californicus*	RB.9	P60%	L	IM+			
170	217	9216			2	*L. californicus*	T	D20%	L	IMA			
171	248	9336			3	*L. californicus*	Z	100%	R	IM+			
172	213	9519			4	*L. californicus*	Z	100%	R	IM+			
173	256	9334			3	*L. californicus*	Z	100%	R	IM+			
174	529	9484			4	*Lepus sp.*	MN	20%	L	IM+			
175	214	9951			4	*Lepus sp.*	MC	100%	R	IM+			

Table III-11. continued

B#	R	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
176	222	9216	NOW1	F+	2	*Lepus sp.*	MP	95%	L	IM+			
177	244	9348			3	*Lepus sp.*	MT	P15%	L	IM+	Y		HE
178	207	9477			4	*Lepus sp.*	R	D20%	R	IM+			
179	203	9504			4	*Lepus sp.*	R	S20%		IM+	Y		HE
180	258	9334			3	*Lepus sp.*	R	S20%		IM+	Y		HE
181	204	9504			4	*Lepus sp.*	S	P15%	L	IM+	Y		HE
182	250	9340			3	*Lepus sp.*	Z	100%	L	IM+			
183	220	9216			2	*Lepus sp.*	Z	100%	R	IM+	Y		HE
184	528	9236			2	*Leporidae*	R	100%		IM+		Y	RG
185	189	9520			4	*C. ludovicianus*	H	100%	R	MAT		Y	W
186	262	9334			3	*C. ludovicianus*	IN	25%		IM+	Y		HE
187	245	9338			3	*C. ludovicianus*	T	D40%					
188	260	9334			3	*C. latrans*	PRM	100%		ADU			CW
189	261	9334			3	*O. hemionus*	PM	80%	L	IM+			
190	210	9552			4	*Squamata*	A	100%		IM+			
191	225	9232			2	*Crysemys sp.*	U	100%	L	IM+			
192	226	9216			2	*Fish*	V-C	95%		IM+			
193	292	11386	NOW1	H	12	*S. auduboni*	T	D15%	R	IM+			
194	412	11100	NOW1	J	11	*H. sapiens*	R	P40%	L	IM+		Y	W
195	383	11108			11	*H. sapiens*	TA	100%	L	IM+		Y	W
196	308	11511			14	*H. sapiens*	UPMO.1	100%		ADU		Y	CW
197	239	11223			12	*S. auduboni*	F	P15%	L	IM+		Y	W
198	274	11202			12	*S. auduboni*	H	D20%	L	IM+			
199	387	11494			1	*S. auduboni*	H	D25%	L	IM+		Y	RG
200	311	12730			0	*S. auduboni*	H	D30%	L	IM+			
201	371	12753			13	*S. auduboni*	H	D50%	L	IM+			
202	291	11386			12	*S. auduboni*	H	P15%	R	IM+			
203	357	12748			13	*S. auduboni*	I	90%	L	IM+	Y		HE
204	271	11202			12	*S. auduboni*	I	100%	L	IM+			
205	287	11212			12	*S. auduboni*	I	100%	R	IMA		Y	W
206	267	11202			12	*S. auduboni*	IN	30%	L	IM+			
207	369	12753			13	*S. auduboni*	IN	50%	L	IM+			
208	410	11125			11	*S. auduboni*	IN	100%	R	IM+		Y	W
209	293	11386			12	*S. auduboni*	IS	100%	L	IM+			
210	342	12814			14	*S. auduboni*	IS	100%	L	IM+			
211	341	12847			14	*S. auduboni*	IS	100%	R	IM+			
212	286	11212			12	*S. auduboni*	IS	100%	R	IMA		Y	W

Table III-11. continued

BN	R	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
213	389	11494	NOW1	J	1	*S. auduboni*	MT.2	100%	L	IM+		Y	RG
214	364	12748			13	*S. auduboni*	MT.2	100%	R	IM+		Y	RG
215	379	11112			11	*S. auduboni*	MT.2	100%	R	IM+		Y	RG
216	352	12730			14	*S. auduboni*	MT.2	P60%	R	IM+			
217	382	11111			11	*S. auduboni*	MT.4	100%	R	IM+		Y	RG
218	270	11202			12	*S. auduboni*	PM	100%	R	IM+			
219	377	11116			11	*S. auduboni*	R	100%	R	IM+			
220	303	11494			14	*S. auduboni*	R	D60%	L	IM+			
221	366	12748			13	*S. auduboni*	R	P20%	L	IM+			
222	263	11344			13	*S. auduboni*	S	20%	L	IM+		Y	W
223	280	11202			12	*S. auduboni*	S	D20%	L	IM+			
224	343	12814			14	*S. auduboni*	S	D40%	R	IM+			
225	290	11386			12	*S. auduboni*	S	P10%	L	IM+			
226	289	11386			12	*S. auduboni*	S	P10%	L	IM+			
227	351	12730			14	*S. auduboni*	S	P10%	R	IM+		Y	W
228	348	12730			14	*S. auduboni*	S	P10%	R	IM+			
229	358	12748			13	*S. auduboni*	S	P20%	L	IM+			
230	398	11087			11	*S. auduboni*	S	P20%	R	IM+			
231	395	11087			11	*S. auduboni*	S	P20%	R	IM+			
232	268	11202			12	*S. auduboni*	S	P30%	L	IM+			
233	324	12813			14	*S. auduboni*	S	P30%	R	IM+			
234	240	11225			12	*S. auduboni*	S	P50%	L	IM+		Y	W
235	323	12813			14	*S. auduboni*	S	P50%	R	IM+			
236	278	11202			12	*S. auduboni*	T	D10%	R	IM+			
237	381	10804			11	*S. auduboni*	T	D15%		IM+	Y		HE
238	277	11202			12	*S. auduboni*	T	D15%	L	IM+			
239	359	12748			13	*S. auduboni*	T	D20%		IM+			
240	391	11216			12	*S. auduboni*	T	D40%	L	IM+			
241	349	12730			14	*S. auduboni*	T	D40%	R	IM+	Y		HE
242	283	11202			12	*S. auduboni*	T	PE	L	IMA			
243	232	11391			13	*S. auduboni*	T	P20%	R	ADU			
244	233	11391			13	*S. auduboni*	T	S		IM+			
245	327	12813			14	*S. auduboni*	T	S20%		IM+		Y	RG
246	388	11494			1	*S. auduboni*	U	100%	L	IM+			
247	409	11120			11	*L. townsendii*	I	70%	R	IM+		Y	W
248	372	11105			13	*L. townsendii*	MN	100%	L	IM+			
249	367	12752			13	*L. townsendii*	MT.2	100%	R	IM+		Y	RG

Table III-11. continued

B#	R	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
250	307	11508	NOW1	J	14	*L. townsendii*	R	D60%	R	IM+			
251	339	12616			14	*L. townsendii*	T	D50%	R	IM+		Y	RG
252	316	12832			0	*L. townsendii*	T	D80%	R	IM+		Y	RG
253	227	11348			13	*L. townsendii*	T	P45%	L	SUB	Y	Y	CM/RG
254	396	11087			11	*L. californicus*	C	50%	R	IM+	Y		HE
255	326	12813			14	*L. californicus*	C	70%	R	IM+			
256	294	11386			12	*L. californicus*	C	80%	L	IM+		Y	W
257	376	11109			11	*L. californicus*	F	100%	R	IMA		Y	RG
258	397	11087			11	*L. californicus*	F	D10%		IMA		Y	W
259	241	11221			12	*L. californicus*	F	D15%	L	IM+		Y	W
260	273	11202			12	*L. californicus*	H	D40%	R	IM+		Y	RG
261	322	12813			14	*L. californicus*	MN	20%	L	IM+			
262	373	11121			13	*L. californicus*	MN	40%	R	IM+		Y	RG
263	385	10163			0	*L. californicus*	MN	90%	R	IM+			
264	370	12753			13	*L. californicus*	MS	100%	L	IM+			
265	321	12813			14	*L. californicus*	M	60%	L	IM+			
266	319	12813			14	*L. californicus*	M	100%	L	IM+			
267	312	12730			0	*L. californicus*	M	100%	L	IM+			
268	393	11087			11	*L. californicus*	M	ZP	R	IM+			
269	402	11087			11	*L. californicus*	MC.3	100%	L	IM+		Y	W
270	411	11085			11	*L. californicus*	MP	100%	L	IM+		Y	W
271	337	12813			14	*L. californicus*	MT	D30%		IM+			
272	390	11217			12	*L. californicus*	MT	P70%	L	IM+		Y	W
273	314	12730			0	*L. californicus*	MT.2	P50%	L	IM+			
274	302	11494			14	*L. californicus*	OS	100%		IM+			
275	235	11350			13	*L. californicus*	PPM	100%		IM+			
276	269	11202			12	*L. californicus*	PM	100%	L	IM+			
277	279	11202			12	*L. californicus*	RB.4	P15%	R	IM+			
278	296	11386			12	*L. californicus*	RB.6	P20%	R	IM+		Y	W
279	344	12814			14	*L. californicus*	RB.6	P30%	L	IM+			
280	334	12813			14	*L. californicus*	RB.8	P35%	R	IM+			
281	353	12748			13	*L. californicus*	S	SB	R	IM+			
282	399	11087			11	*L. californicus*	SQ	100%	R	IM+			
283	301	11494			14	*L. californicus*	SQ	100%	R	IM+			
284	304	11494			14	*L. californicus*	SQ	100%	R	IM+			
285	375	11100			11	*L. californicus*	SQ	100%	R	IM+			
286	236	11215			13	*L. californicus*	T	D20%	R	IMA			

Table III-11. continued

B#	R	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
287	392	11118	NOW1	J	11	*L. californicus*	T	D40%	R	IM+		Y	RG
288	228	11348			13	*L. californicus*	T	D70%	R	IM+		Y	RG
289	275	11202			12	*L. californicus*	T	PE	R	IMA			
290	281	11202			12	*L. californicus*	T	S20%	L	IM+		Y	W
291	405	11124			11	*L. californicus*	V-SAC	100%		IMA			
292	229	11345			13	*Lepus sp.*	F	D20%	R	ADU	Y		CM
293	234	11393			13	*Lepus sp.*	F	P25%	R	IM+		Y	RE
294	272	11202			12	*Lepus sp.*	MNF	100%	L	IM+			
295	378	11117			11	*Lepus sp.*	MS	100%	R	IM+			
296	315	12730			0	*Lepus sp.*	MC	100%	R	IM+			
297	284	11202			12	*Lepus sp.*	MC	P95%	R	IM+			
298	264	11344			13	*Lepus sp.*	MP	D25%		IM+			
299	332	12813			14	*Lepus sp.*	MT	100%		IM+			
300	346	12734			14	*Lepus sp.*	MT	100%	L	IM+			
301	365	12748			13	*Lepus sp.*	MT	D50%	L	IM+			
302	330	12813			14	*Lepus sp.*	MT	P95%	R	IM+			
303	333	13813			14	*Lepus sp.*	MT.3	P30%	L	IM+			
304	368	12752			13	*Lepus sp.*	MT.4	100%	L	IM+		Y	RG
305	360	12748			13	*Lepus sp.*	MT.4	D30%	L	IM+			
306	285	11202			12	*Lepus sp.*	PH	100%		IM+		Y	W
307	282	11202			12	*Lepus sp.*	R	P15%	R	IM+			
308	347	12734			14	*Lepus sp.*	R	S20%		IM+			
309	401	11087			11	*Lepus sp.*	RB	P25%	R	IM+			
310	265	11344			13	*Lepus sp.*	S	20%		IM+			
311	288	11386			12	*Lepus sp.*	S	P20%	L	IM+			
312	325	12813			14	*Lepus sp.*	S	P25%	R	IM+			
313	230	11297			13	*Lepus sp.*	T	D20%	R	IM+		Y	RE/RG
314	306	11509			14	*Lepus sp.*	T	D25%	L	IM+		Y	RG/W
315	404	10807			11	*Lepus sp.*	V-L	80%		IM+			
316	238	11222			12	*Lepus sp.*	V-L	100%		IM+		Y	W
317	406	11124			11	*Leporidae*	V-C	100%		IM+			
318	317	12832			14	*C. ludovicianus*	H	D25%	L	IM+			
319	231	11395			13	*C. ludovicianus*	T	D10%	R	IM+			
320	408	11103			11	*G. bursarius*	F	100%	R	IMA		Y	RE
321	320	12813			14	*G. bursarius*	MN	D20%	R	IM+			
322	336	12813			14	*D. ordii*	F	P40%	R	IM+			
323	380	10804			11	*D. ordii*	H	100%	R	IM+			

Table III-11. continued

R#	R	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
324	335	12813	NOW1	J	14	*D. ordii*	H	D40%	L	IM+			
325	355	12748			13	*D. ordii*	MN	75%	R	IM+			
326	313	12730			0	*D. ordii*	MN	80%	R	IM+			
327	318	12813			14	*D. ordii*	MN	100%	L	IM+			
328	354	12748			13	*N. albigula*	F	P25%	L	IM+			
329	400	11087			11	*N. albigula*	F	P40%	R	IM+			
330	407	11114			11	*N. albigula*	F	P50%	R	IM+		Y	RG
331	309	11512			14	*N. albigula*	H	100%	L	ADU			
332	394	11087			11	*N. albigula*	MN	20%	R	IM+			
333	266	11202			12	*N. albigula*	MN	75%	L	IM+		Y	W
334	356	12748			13	*N. albigula*	M	100%	R	IM+			
335	305	11494			14	*N. albigula*	M	100%	R	IM+			
336	297	11386			12	*N. albigula*	R	D60%	L	IM+			
337	276	11202			12	*C. latrans*	T	D10%	L	IM+		Y	RG/W
338	237	11219			12	*C. latrans*	U	P25%	R	IMA		Y	W
339	340	11216			14	*Vulpes sp.*	R	100%	R	JUV		Y	RG
340	374	11107			11	*O. hemionus*	AB	100%	R	IM+		Y	W
341	328	12813			14	*Bovidae*	PRM	10%	R	IM+			F
342	299	11386			12	*Mammalia*	RB	40%	R	IM+			
343	331	12813			14	*Squamata*	V	100%		IM+			
344	386	11494			1	*Squamata*	V	100%		IM+			
345	338	12813			14	*Avies*	H	D30%		IM+			
346	329	12813			14	*Avies*	H	D50%	L	IM+			
347	300	11494			14	*Phasianidae*	TMT	D20%	L	IM+		Y	W
348	295	11386			12	*Phasianidae*	T	90%	L	IM+	Y	Y	HE/RG
349	361	12748			13	*A. flammeus*	CP	P20%	R	IM+			
350	362	12748			13	*A. flammeus*	CO	40%	L	IM+			
351	345	12734			14	*A. flammeus*	F	P90%	R	IM+			
352	413	11102			11	*Strigidae*	H	S60%	R	IM+		Y	RE
353	298	11386			12	*Bufonidae*	IN	90%	L	IM+			
354	363	12748			13	*Ranidae*	TB	S25%	R	IM+			
355	310	11394	NOW1	J1	14	*S. auduboni*	IN	100%	L	IM+			
356	514	17083	NOW1	M1	23	*L. californicus*	U	P15%	L	ADU		Y	W
357	513	17083			23	*Lepus sp.*	H	D40%	L	IM+		Y	RE
358	510	10751	NOW1	πJ	10	*L. californicus*	H	S60%	L	IM+		Y	RE
359	525	0			0	*L. californicus*	M	100%		IM+		Y	W
360	415	10669			11	*C. ludovicianus*	T	P40%	L	IM+		Y	W

Table III-11. continued

B#	R	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
361	182	9138	NOW1	D	5	*S. auduboni*	F	D20%	L	IM+			
362	166	9141			3	*S. auduboni*	H	D20%	L	IM+			
363	170	9112			3	*S. auduboni*	H	P10%	R	ADU			
364	175	9112			5	*S. auduboni*	I	30%	R	IM+			
365	168	9112			3	*S. auduboni*	S	P30%	L	IM+			
366	130	11146			11	*L. townsendii*	MT	100%	L	IM+		Y	W
367	137	0			8	*L. californicus*	C	100%	R	IM+	Y		HE
368	136	9556			5	*L. californicus*	H	D40%	R	ADU		Y	W
369	140	9375			4	*L. californicus*	MT.3	100%	L	ADU		Y	W
370	172	9554			5	*L. californicus*	PM	100%	L	IM+		Y	W
371	130	9553			5	*L. californicus*	S	P25%	R	IM+			
372	131	9115			3	*L. californicus*	S	P30%	L	IM+			
373	134	9122			3	*L. californicus*	S	P60%	R	ADU		Y	W
374	176	9112			5	*Lepus sp.*	AB	20%	L	IM+			
375	165	9137			3	*Lepus sp.*	AB	40%		IM+			
376	181	9371			5	*Lepus sp.*	H	D10%	L	JUV	Y		HE
377	157	9980			7	*Lepus sp.*	H	D20%	L	IMA	Y		HE
378	135	9552			5	*Lepus sp.*	H	D40%	R	SBA		Y	W
379	171	9112			3	*Lepus sp.*	INC	100%		IM+			
380	186	9138			5	*Lepus sp.*	MC	P40%	R	IM+			
381	174	9112			5	*Lepus sp.*	MC.3	P70%	L	IM+			
382	162	9732			6	*Lepus sp.*	MP	100%	L	IM+			
383	146	9376			4	*Lepus sp.*	RB	80%	R	IM+		Y	RG
384	164	9732			6	*Lepus sp.*	ST.3	100%		IM+			
385	167	9123			3	*Lepus sp.*	T	P15%		IM+			
386	138	0			8	*Leporidae*	MT	100%	R	IM+			
387	151	0			8	*N. albigula*	T	D70%	L	IM+			
388	153	9142			3	*N. albigula*	Z	100%	L	IM+			
389	184	9138			5	*Canidae*	AB	100%	L	IM+			
390	141	9146			3	*C. latrans*	CAN	80%		IM+			
391	173	9112			5	*Vulpes sp.*	MO.2	100%		ADU		Y	CW
392	142	9131			3	*Bovidae*	MO	60%		IM+			
393	179	9112			5	*Avies*	UN	S		IM+		Y	P
394	257	9334	NOW1	F+	3	*S. auduboni*	C	100%	R	IM+		Y	W
395	254	9334			3	*S. auduboni*	H	D70%	R	IM+			
396	191	9517			4	*S. auduboni*	I	P70%	R	IM+		Y	W
397	194	9504			1	*L. townsendii*	MN	25%	L	IM+		Y	W

Table III-11. continued

B#	R	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
398	192	9477	NOW1	F+	1	*S. auduboni*	S	P40%	R	IM+			
399	150	9019			1	*L. townsendii*	Z	100%	R	IM+	Y		HE
400	255	9334			3	*L. californicus*	F	D15%	L	ADU	Y		HE
401	199	9489			4	*L. californicus*	H	D25%	R	IMA		Y	W
402	196	9504			1	*L. californicus*	RB	D20%		IM+			
403	147	9020			1	*Lepus sp.*	MT.3	P70%	L	IM+		Y	W
404	149	9020			1	*Lepus sp.*	PH	P40%		IM+	Y		HE
405	148	9020			1	*Lepus sp.*	S	D10%	R	IM+			
406	190	9486			4	*Vulpes sp.*	U	P40%	L	IM+		Y	W
407	350	12730	NOW1	J	14	*N. albigula*	M	100%	L	IM+			
408	26	21502	S2W3	A	1	*S. auduboni*	IN	75%	L	IM+			
409	24	21501			1	*L. townsendii*	H	D25%	L	IM+			
410	25	21500			1	*L. californicus*	H	D15%	R	IM+		Y	W
411	6	12627			1	*Mammalia*	UN	S20%		IM+	Y		CMD
412	29	21619	S2W3	B	2	*S. auduboni*	H	D25%	R	IM+			
413	28	21583			2	*L. californicus*	IN	50%	R	ADU			
414	32	21619			2	*L. californicus*	PH.2	PC		ADU			
415	33	21619			2	*L. californicus*	PH.4	PC		ADU			
416	31	21619			2	*L. californicus*	PH.4	PC		ADU			
417	30	21619			2	*N. albigula*	I	25%	L	IM+			
418	34	21619			2	*L. rufus*	A	25%		IM+			
419	35	21619			2	*O. hemionus*	MO	25%T/R		IM+			
420	36	21619			2	*Mammalia*	UN	S10%			Y		HE
421	27	21583	S2W3	C	3	*L. californicus*	H	D25%	L	IM+			
422	49	21914	S2W3	D	5	*L. townsendii*	M	25%	R	ADU			
423	37	21905			5	*L. townsendii*	PH.3	P40%		IM+	Y		HE
424	39	21900			5	*L. californicus*	M	25%	L	IM+			
425	38	21699			0	*L. californicus*	MC	P25%		IM+	Y		HE
426	41	21900			5	*L. californicus*	MT	P25%	R	IM+		Y	RG/W
427	44	2190			5	*L. californicus*	R	S25%	L	IM+			
428	50	21705			4	*Lepus sp.*	IS	25%	L	IM+			
429	45	21918			5	*Lepus sp.*	PH	P75%		IM+			HE?
430	40	21900			5	*N. albigula*	MN	40%	L	IM+			
431	46	21519			4	*N. albigula*	MN	80%	R	IM+			
432	42	21900			5	*C. latrans*	PRM.4	R/C50%		IM+			
433	47	21595			4	*Mammalia*	L(UN)	F			Y		SF/C
434	43	21900			5	*Mammalia*	L (UN)	S25%			Y		HE

Table III-11. continued

R#	B	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
435	48	21917	S2W3	D	5	*Rodentia*	V	V50%					
436	51	22038	S2W3	D1	0	*S. audubonі*	S	25%	R	IM+			
437	10	13530			7	*L. californicus*	PH.3	100%		IM+			
438	53	22038				*Mammalia*	L (UN)	S10%			Y		HE
439	52	22038				*Mammalia*	L (UN)	S10%			Y		SF
440	60	22152	S2W3	D2	7	*S. audubonі*	C	100%	L	IM+			
441	62	22521			7	*S. audubonі*	H	D15%	L	IM+			
442	61	22152			7	*S. audubonі*	H	D25%	R	IM+			
443	73	22152			7	*S. audubonі*	M	CZ	L	IM+			
444	57	22139			7	*S. audubonі*	R	P50%	L	ADU			
445	66	22152			7	*S. audubonі*	R	P75%	R	IM+		Y	W
446	59	22145			7	*L. californicus*	MN	75%	L	IM+			
447	56	22139			7	*L. californicus*	MP	P75%	L	IM+			
448	65	22152			7	*Lepus sp.*	MN	P10%		IM+			
449	68	22152			7	*Lepus sp.*	M	CZ	R	IM+			
450	64	22152			7	*Lepus sp.*	M	CZ	R	IM+			
451	54	22159				*Lepus sp.*	MT.2	100%	R	IM+			
452	63	22152			7	*Lepus sp.*	S	15%	R	IM+	Y		HE
453	70	22152			7	*Neotoma sp.*	M	CZ	L	IM+			
454	71	22152			7	*Bovidae*	TTH	25%		IM+			
455	67	22152			7	*Bovidae*	TTH	30%		IM+			
456	72	22152			7	*Bovidae*	TTH	M20%		IM+			
457	58	22139			7	*Bovidae*	V-T	25%	L	IM+			
458	55	22169			7	*Bovidae*	V-T	DO15%		IM+		Y	W
459	69	22152			7	*Rodentia*	MN	50%	R	IM+			
460	94	22322	S2W3	E	8	*S. audubonі*	M	CZ	L	IM+			
461	93	22322			8	*S. audubonі*	R	S20%		IM+			
462	86	22322			8	*L. townsendii*	M	CZ	L	IM+			
463	82	22322			8	*L. townsendii*	PM	20%	L	IM+			
464	78	22339			8	*L. californicus*	MT.4	P50%	R	IM+			
465	79	22328			8	*L. californicus*	PH	PC		IM+	Y		HE
466	83	22322			8	*L. californicus*	R	P20%		IM+			
467	92	22322			8	*Lepus sp.*	INC	100%		IM+			
468	85	22322			8	*Lepus sp.*	M	CZ	L	IM+	Y		HE
469	75	22641			9	*Lepus sp.*	MC.3	100%	R	IM+	Y		W
470	88	22323			8	*Lepus sp.*	PH	PC		IM+			
471	90	22323			8	*Lepus sp.*	R	S20%		IM+	Y		HE

Table III-11. continued

B#	R	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
472	77	22634	S2W3	F	9	*C. ludovicianus*	MN	90%	L	IM+			
473	74	22636			9	*C. ludovicianus*	RB	100%		IM+			
474	84	22322			8	*E. dorsalis*	F	P20%	L	IM+			
475	76	22640			9	*Vulpes sp.*	T	D15%	L	IM+		Y	W
476	80	22329			8	*Squamata*	V	80%		IM+			
477	91	22322			8	*Squamata*	V	90%		IM+			
478	89	22323			8	*Chrysemys*	PL	F		IM+			
479	81	22330			8	*Avies*	H	100%	L	IM+			
480	87	22322			8	*Avies*	UN	I		IM+			
481	112	21495			1	*S. auduboni*	H	D30%	L	IM+			
482	120	23447			9	*S. auduboni*	H	D30%	R	IM+	Y		HE
483	119	23447			9	*S. auduboni*	S	P40%	R	IMA			
484	113	21495			1	*S. auduboni*	T	D30%	R	IM+	Y		HE
485	116	23447			9	*S. auduboni*	T	P20%	R	IMA	Y		HE
486	115	21495			1	*S. auduboni*	V-L	25%		IM+			
487	114	21495			1	*S. auduboni*	V-L	25%		IM+			
488	105	22646			9	*S. auduboni*	V-T	100%		IM+			
489	96	22337			9	*L. californicus*	F	D20%	R	IM+			
490	111	22642			9	*L. californicus*	H	D40%	R	IM+			
491	118	23447			9	*L. californicus*	I	100%	L	IMA			
492	103	22645			9	*L. californicus*	MN	60%	L	IM+			T
493	107	22468			9	*L. californicus*	MN	80%	R	IM+			
494	100	14359			9	*L. californicus*	M	CZ	R	IM+			
495	106	22473			9	*L. californicus*	MT	100%	R	IM+		Y	W
496	95	22635			9	*L. californicus*	PM	75%		IM+			
497	126	22472			9	*L. californicus*	Z	100%	R	IM+	Y		HE
498	98	22466			9	*Lepus sp.*	AB	100%	L	IM+			
499	104	22642			9	*Lepus sp.*	H	D20%	L	IM+			
500	122	14359			9	*Lepus sp.*	INC	100%		IM+			
501	125	22467			9	*Lepus sp.*	MP	100%		IM+			
502	108	22468			9	*Lepus sp.*	MT	100%	L	IM+			
503	102	22638			9	*Lepus sp.*	R	40%	L	IM+			
504	123	14359			9	*Lepus sp.*	R	S40%		IM+	Y		HE
505	97	22475			9	*Lepus sp.*	U	70%	R	ADU			
506	117	23447			9	*Sciuridae*	MN	90%	L	IM+			
507	101	22633			9	*C. ludovicianus*	MN	100%	R	IM+			
508	121	14359			9	*C. latrans*	Z	P30%	R	IM+	Y		HE

Table III-11. continued

RN	R	CN	PR	Z	L	SPECIES	E	P	S	A	CM	NM	C
509	109	22470	S2W3	F	9	*Cervidae*	RB	40%	L	IM+			
510	110	22469			9	*Bovidae*	RB	30%	L	IM+			
511	99	14359			9	*Bovidae*	S	30%	R	IM+		Y	W
512	124	22646			9	*Mammalia*	A	100%		IM+			
513	129	22346	S3W3	K	1	*L. californicus*	INC	100%		IM+			
514	128	22346			13	*L. californicus*	MC	P60%		IM+		Y	W
515	127	22350			13	*L. californicus*	MT.2	100%	L	MAT		Y	W
516	3	12627	S3W2	A	1	*L. californicus*	PH.3	100%		IM+			
517	4	12627			1	*Lepus sp.*	PH.2	100%		IM+			
518	1	12683	S3W2	B	2	*L. californicus*	MT.4	D25%		IM+			
519	2	12683			2	*C. familiaris*	Z	25%	R	IM+		Y	G
520	5	12683			2	*B. taurus*	TTH	F		IM+			
521	7	13286	S3W2	D	5	*L. californicus*	MN	50%	R	ADU			
522	9	13288			5	*B. taurus*	S	15%	L	ADU	Y		CM
523	8	13286			5	*Squamata*	V	100%		IM+			
524	11	13531	S3W2	D1	7	*O. hemionus*	PRM	50%		ADU			
525	13	13706			8	*S. auduboni*	C	100%	L	IM+			
526	14	13695			8	*L. townsendii*	MN	10%	L	IM+			F
527	12	13697	S3W2	D2	8	*L. californicus*	PH.2	100%		IM+			
528	15	13695			8	*L. californicus*	U	PE	R	ADU			
529	16	13715	S3W2	E	9	*Heteromyidae*	R	100%		IM+			
530	17	13723	S3W2	F	10	*L. californicus*	V-L	V25%		IM+			
531	23	23194	S3W2	F+	9	*L. californicus*	PH	P50%		ADU			
532	18	13728	S3W2	I	10	*S. auduboni*	AST	100%	L	IM+			
533	22	13728			10	*S. auduboni*	V-T	V25%		IM+			
534	21	13728			10	*L. californicus*	MN	50%	R	IM+			
535	19	13728			1	*Rodentia*	IN	25%					
536	20	13728			10	*Rodentia*	R	D25%					

Section 3

The Evolution of Maize in the Jornada Region of New Mexico and its Implications for the Southwest

Steadman Upham and R.S. MacNeish

This article is an outgrowth of an earlier paper that was concerned specifically with Maiz de Ocho, written by the present authors in conjunction with Walton C. Galinat and Christopher Stevenson (Upham et al. 1987). Although a few more corn specimens have been added to our sample (and analyzed by the present authors), much of the data from the corncobs Galinat carefully analyzed, described, and interpreted are the same. The dates related to the materials, however, have changed considerably; even the original hydration dates have been recalibrated by Stevenson. Both these changes show the corn in this area is much older than usually is assumed for the Southwest (Berry 1982; Minnis 1985). To Upham and MacNeish (1987), but not Galinat, the determination giving older dates for the Jornada region, in conjunction with new corn data from other parts of the Southwest (Wills 1988), has important implications for the much larger problem of the origin and spread of corn in the American Southwest. In fact, we believe we now can make some valid estimates of when corn reached the Southwest from Mesoamerica and when it spread to the various parts of the Southwest–in fact, we even can hypothesize about the route this diffusion took. Further, we have some indications of how and when corn evolved in the Southwest and can even speculate about why agriculture came into being there. In other words, we believe we now are able to use our new and better data to attack much larger cultural problems and processes.

Most of the corn under discussion came from the rockshelters located in the southern end of the Organ Mountains, some 10 miles east of Las Cruces (Upham et al. 1987). Most of the corncobs studied (37) came from the nine levels of Roller Skate Rockshelter, while 27 came from the five stratified zones of Tornillo Rockshelter. Our analysis also included 14 cobs from the five levels of Knee Pad Shelter and two cobs from the long, narrow Sonrisa Shelter.

To this original sample we now have added 17 cobs from the top four stratified Ceramic zones of Todsen Shelter, located in Spring Canyon just northwest of Las Cruces. We also consider relevant to this discussion the three cobs and 11 brown Chapalote kernels from pit 4 of zone F as well as kernels and leaves from zones C and C2 (O'Laughlin 1980) of Fresnal Shelter up (6,300 feet above sea level) in the Sacramento Mountains some 10 miles northeast of Alamogordo. The Fresnal samples were brought to our attention by David Carmichael, who also helped date the stratigraphy of Fresnal (Carmichael 1981). Also relevant is the corn pollen from zone 2 (radiocarbon dated between 2360 and 1590 B.C.) of the Keystone site just north of El Paso (O'Laughlin 1980).

What really is new about these corn materials is that we now understand the cultural phases with which they are associated in the different levels, zones, or strata at the various stratified sites. We also have a host of new radiocarbon determinations–that either date these components directly or at least date related ones–to supplement the revised obsidian hydration dates.

Dating the Corn Samples

Our excavation of ten stratified sites and careful analysis of the materials recovered (as well as the projectile points from Fresnal, La Cueva, and Keystone) allow us to classify each component into the relevant phase–Fresnal (2600-900 B.C.), Hueco (900 B.C.-A.D. 250), Mesilla (A.D. 250-1000), Doña Ana (A.D. 1000-1150), and El Paso (A.D. 1150-1350). Moreover, on the basis of artifact trends, we can place the components in their chronological order and also date many of them by radiocarbon or obsidian hydration methods (see Table III-12).

The date of 2560 B.C. for feature 11 at North Mesa, with its Keystone artifacts, as well as House 2 of Keystone with Pelona and Langtry points and a date of 2790 B.C., seem to mark the end of the Keystone phase, which does not have corn. In the subsequent Fresnal period, however, we do have good evidence of corn (as well as beans, squash, and amaranth).

Fresnal. The date for Keystone allows us to estimate that the Fresnal phase began about 2600 B.C. Whether corn appears at the beginning of the phase is unknown at present, but corn pollen did appear in zone 4 of the Keystone site, which bears dates of 1590, 1910, 2090, and 2350 B.C. Somewhat confirming these dates for early corn is the date of 1510 B.C. on charcoal found in direct association with three Chapalote corncobs in pit 3 of zone F1 at Fresnal Cave. (A date of 1360 B.C. on charcoal nearby in zone C2 of Fresnal also might be associated with corn, but the data are not complete enough to include it.) Almost as early were three Chapalote and three Proto-Maiz de Ocho cobs from zone D of Tornillo Cave, which were dated directly at 1225 B.C., although the associated artifacts were very limited. Artifacts from feature 2 of the North Mesa site, which bore a date of 1260 B.C., and middle zone B of the same site with a date of 1140 B.C., definitely were Fresnal phase types. Also, two corncobs from zone C at Tornillo were associated with an obsidian chip that dated to 1025 B.C.

Identifying the end of the Fresnal phase is difficult because charcoal from three different locations in zone J of Todsen Cave (which is associated with non-Fresnal artifacts) gave dates of 860, 910, 930, and 960 B.C., while charcoal from zone C of Fresnal Cave, which has Early Hueco artifacts as well as corncobs, gave dates of 952 and 1010 B.C. Our estimate that places the end of the Fresnal phase at 900 B.C. thus has some possible range of error; in fact, the actual Fresnal dates range from 2350 to 860 B.C. and are based upon 12-14 radiocarbon determinations and an obsidian hydration date obtained from ten components of four stratified sites.

Hueco. We have better dating on Hueco, the following and final Archaic phase, and a wider sample of corncobs from stratified contexts. As mentioned, the rather early dates of 925 and 1010 B.C. for zone C of Fresnal seemingly were associated with corncobs and Hueco artifacts. Somewhat better dated and more definitely associated with many Hueco artifacts was Todsen zone E2, with its burial 6, that has dates of 800 and 200 B.C. Zone E in the same cave, associated with a corn leaf, as well as burial 4, gave a radiocarbon determination of 600 B.C., and associated obsidian yielded a confirmatory reading of 548 B.C. Charcoal from zone πJ of Todsen, a downslope extension of zones E, E1, and E2 with a huge sample of Hueco artifacts, including two-handed manos and trough metates, gave a radiocarbon determination of 810 B.C. and two flakes of obsidian dated at 812 and 490 B.C. Feature 5 of North Mesa, with similar proportions of Hueco artifacts, yielded a radiocarbon determination of 460 B.C.

In terms of artifact trends, these components seem to be contemporaneous with components found with corncobs in the Organ Mountain shelters, specifically levels 1-5 of Knee Pad, level 6 of Sonrisa, levels 6-9 of Roller Skate, and zone A1 of Tornillo. Obsidian chips from zone A1 of Tornillo and level 6 of Roller Skate gave readings of 548 B.C. and 138 B.C., respectively. Only levels 4 and 5 of Roller Skate had corncobs; their artifact trends seem to belong to Late Hueco times. Zone 2 of Keystone had radiocarbon dates of 130 and 160 B.C., while zone B of Fresnal was dated at 125 B.C.; feature 2 of North Mesa was A.D. 40. Zone E of Todsen was A.D. 150, and an obsidian chip from this same zone gave a date of A.D. 187, as did a chip from level 3 of Sonrisa; while level 5 of Peña Blanca was dated at A.D. 244 and level 2 of Sonrisa at A.D. 260 and 308.

Although many new races of corn appear in Hueco times and are dated very well, our carbon 13/12 and nitrogen 15/14 analyses (see Section 4 of this chapter) indicate true agriculture still had not arrived in the Jornada region.

Mesilla. Analyses of bone collagen from skeletons of the Mesilla phase indicate full-time agriculture did not arrive in the Jornada region until after the end of that period. Our quite adequate sample of corn for the Mesilla phase indicates few major changes had taken place since Late Hueco times. Although our only obsidian dates are A.D. 88 from level 3 of Roller Skate and A.D. 729 from zone D1 of Todsen during the Mesilla-Doña Ana transition, other Mesilla sites yielded a host of radiocarbon determinations within the A.D. 250-950 range.

Doña Ana and El Paso. During the two following phases, Doña Ana and El Paso, C13/12 and N15/14 isotopic analyses of skeletons indicate agriculture had reached the Jornada region at last. A few corncobs come from level 1 of Roller Skate and zone D1 of Todsen. Peña Blanca, level 3, had charcoal that was radiocarbon dated at A.D. 1150 and 1160 and an obsidian chip dated at A.D. 773. A chip from level 4 of Rincon was dated at A.D. 994, and chips from levels 2 and 3 of the same level dated A.D. 1118 and 1135, respectively.

Table III-12. Dates of Components with Relevant Corn in the Jornada Region

KEY:
C14 DET. = Radiocarbon Determination   OB. EST. = Obsidian Hydration Estimate

NORTH MESA	FRESNAL	TORREON	PEÑA BLANCA	RINCON	KEYSTONE	TORNILLO	KNEE PAD	SONRISA	ROLLER SKATE	THORN	C14 DET.	OB. EST.	PHASE
		C										A.D. 1625, 1675	
			1										A.D. 1350
			2								A.D. 1330, 1420	A.D. 1084	
		D											
				1									EL PASO
				2								A.D. 1135	
				3								A.D. 1118	
										1			
									1				A.D. 1150
				4								A.D. 994	DOÑA ANA
			3								A.D. 1150, 1160	A.D. 783	
		D1										A.D. 729	A.D. 900
			4										
		F+								2			
									2				
								1					MESILLA
			5									A.D. 88	
AB													
		D2											
						A1							A.D. 250

Table III-12. continued

NORTH MESA	FRESNAL	TODSEN	PEÑA BLANCA	RINCON	KEYSTONE	TORNILLO	KNEE PAD	SONRISA	ROLLER SKATE	THORN	C14 DET.	OB. EST.	PHASE
								2				A.D. 260, 308	A.D. 250
				5								A.D. 244	
										3			
			6										
										4			
									4				
								3				A.D. 182	
		E									A.D. 150	A.D. 187	
F3													
									5				
F7											A.D. 40		
	B										125 B.C.		
					Z2						130, 160 B.C.		HUECO
									6			138 B.C.	
									7-9				
F5											460 B.C.		
								4-5					
							1						
						A						548 B.C.	
							2						
		E1									600 B.C.	548 B.C.	
		πJ									810 B.C.	490, 817 B.C.	850 B.C.

Table III-12. continued

NORTH MESA	FRESNAL	TODSEN	PEÑA BLANCA	RINCON	KEYSTONE	TORNILLO	KNEE PAD	SONRISA	ROLLER SKATE	THORN	C14 DET.	OB. EST.	PHASE
		E2									850, 200 B.C.		850 B.C.
		J										860, 910, 930, 960, B.C.	
	C											925, 1010 B.C.	
						B							
						C						1025 B.C.	
mid-B											1140 B.C.		FRESNAL
						D					1225 B.C.		
F2											1260 B.C.		
	C2										1360 B.C.		
	F										1510 B.C.		
					Z2a						1590, 1910, 2090, 2350 B.C.		
													2600 B.C.

The El Paso phase yielded corn we studied only in zone D of Todsen. Some unstudied cobs recovered from the upper level 2 of Peña Blanca were radiocarbon dated at A.D. 1330 and 1420, while an obsidian chip yielded a date of A.D. 1084. Like the Mesilla phase, both the Doña Ana and El Paso phases are dated well by specimens recovered from excavations other than those we did. All in all, our corn sequence is dated extremely well–but as always, more specimens for study would be most welcome.

Corn Races Found in the Jornada Region

Before we discuss the development of corn races in this long sequence of 3,500 years, let us say a word about the races themselves, using mainly the dates previously reported (Upham et al. 1987). Most measurements and racial clas-

sifications initially were made by Galinat. As we have indicated, we are not enamored with the concept of corn races nor do we think they can be defined rigidly. We see races as congeries of traits, genetically backed, that humans have selected for certain specific cultural purposes (often environmental adaptations), which means they often may be duplicated; distinguishing where one race ends and the evolving race begins is often difficult. In spite of these limitations we find the classification useful for our attempts to reconstruct culture history. Following is a description of the races of corn we uncovered and tables with some of the measurable characteristics.

Chapalote. The earliest corn in the Southwest seems to be Chapalote, which evolved early in the highland tropics of Mesoamerica. This race has small, hard, brown kernels that can be popped. As Table III-13 indicates, Chapalote corn is multirowed (10-14 rows), relatively thick and short (39-47 mm long), with kernels close together.

Table III-13. Characteristics of Chapalote Corn Excavated in the Jornada Region

Phase	Site	Level	Cat. No.	Kernel Row Number	Avg. Rachis Diameter in mm	Avg. Internodal Length in mm	Index of Condensation
El Paso	Roller Skate	1	181a	14	12	3	4.7
	Roller Skate	2	131c	14	8.7	2.5	5.6
	Roller Skate	2	1094	14	13	3.8	3.7
Mesilla	Sonrisa	1		12	12	NA	NA
	Roller Skate	3	1393	10	9	3.6	3.9
	Roller Skate	3	1088	14	12.2	3.6	3.9
	Roller Skate	3	1427a	14	11.8	7	2
	Roller Skate	4	462	14	7.5	4.5	3.1
	Roller Skate	4	615	14	11	4.8	2.9
Hueco	Tornillo	A1		14	12	NA	NA
	Roller Skate	7	1115	14	11.5	3.5	4
	Roller Skate	7	1471a	14	9.2	4.6	3
	Roller Skate	9	1476c	14	13.2	5.5	2.6
	Roller Skate	9	1476d	14	10.1	4.5	2.6
Fresnal	Tornillo	D	7067	12	11.2	NA	NA
	Tornillo	D	7089	14	13.6	NA	NA

NA = not analyzed

Proto-Maiz de Ocho. Chapalote is followed by Proto-Maiz de Ocho, which is quite different, having large, soft, yellowish kernels, reduced kernel row numbers (eight), and a lower rachis diameter. It is relatively short (29.33-36 mm) and perhaps flowers earlier. The illustration shows this race is even smaller in length and diameter than Chapalote, out of whose gene pool it may have been selected (see Table III-14).

Table III-14. Characteristics of Proto-Maiz de Ocho Excavated in the Jornada Region

Phase	Site	Level	Cat. No.	Kernel Row Number	Avg. Rachis Diameter in mm	Avg. Internodal Length in mm	Index of Condensation
El Paso	Roller Skate	2	131a	8	8	3.3	2.3
	Roller Skate	2	439	8	6.6	3.8	2.1
Mesilla	Roller Skate	3	699	8	4.8	3.2	2.5
	Roller Skate	3	1040	8	8.5	4.4	1.8
	Roller Skate	3	1398	8	6	4.3	1.9
	Roller Skate	3	1415	8	7	3.7	2.2
Hueco	Roller Skate	5	1424	8	7.3	4	2
	Roller Skate	5	1489	8	9.5	4.5	1.8
	Roller Skate	6	1047	8	8.8	5.3	1.5
	Roller Skate	6	1472a	8	8.4	3.2	2.5
	Roller Skate	7	1047	8	4	4.4	1.8
	Roller Skate	7	1035b	8	4	3.5	1.8
	Roller Skate	7	1035b	8	3.6	3.2	2.5
	Roller Skate	7	1471b	8	7.6	4.8	1.6
	Roller Skate	7	1476a	8	7.3	3.8	2.1
	Roller Skate	9	1402a	8	1.8	3.7	2.2
	Tornillo	A1		8	3	NA	NA
	Tornillo	B		8	6.9	NA	NA
Fresnal	Tornillo	C		8	7	NA	NA
	Tornillo	D	7063	8	6.8	NA	NA
	Knee Pad	4	1424	8	7.3	4	2
	Tornillo	D	7097	8	7.1	NA	NA

NA = not available

Maiz de Ocho. It would appear this transitional race gradually evolved or was selected to become Maiz de Ocho (often called Basketmaker corn in the Southwest), which had even bigger kernels, more varied color, increased rachis thickness, greater length (36-60 mm), and was even better adapted to the hot, arid Southwestern desert, but had the same limited number of rows (eight) (see Table III-15).

Pima-Papago. Appearing even later in the sequence–and perhaps grown in better watered (that is, irrigated) situations–was a much larger race with even more variety in color and larger kernels. This Pima-Papago race is 56-72 mm long and has a 12-16 mm rachis diameter (see Table III-16).

Table III-15. Characteristics of Maiz de Ocho Excavated in the Jornada Region

Phase	Site	Level	Cat. No.	Kernel Row Number	Avg. Rachis Diameter in mm	Avg. Internodal Length in mm	Index of Condensation
El Paso	Todsen	D		8	15.8	NA	NA
Doña Ana	Todsen	D1		8	12	NA	NA
Mesilla	Todsen	D2		8	14	NA	NA
	Tornillo	A		8	10.5	NA	NA
	Roller Skate	4	1093	8	10	3.1	1.7
Hueco	Roller Skate	5	1489-3	8	9.5	4.5	1.8
	Roller Skate	5	1489-7	8	10.2	5	1.6
	Tornillo	A1		8	10	NA	NA

NA = not available

Table III-16. Characteristics of Pima-Papago Corn Excavated in the Jornada Region

Phase	Site	Level	Cat. No.	Kernel Row Number	Avg. Rachis Diameter in mm	Avg. Internodal Length in mm	Index of Condensation
El Paso	Todsen	D		16	14.8	NA	NA
Doña Ana	Todsen	D1		18	15.6	NA	NA
Mesilla	Todsen	D1		16	13.5	NA	NA
	Todsen	D2		14	13.2	NA	NA
	Todsen	D2		16	12.8	NA	NA
	Roller Skate	5	1489-8	14	17.7	5	2.8
Hueco	Roller Skate	6	1695	14	12.8	5	2.8
	Roller Skate	6	1472a	12	12.1	4.5	2.7
	Tornillo	A1		14	12.8	NA	NA

NA = not available

Pueblo. The final corn race, Pueblo, does not seem to arrive in the Jornada region until Doña Ana and/or El Paso times, when full-time agriculture was in vogue. It has even more rows, bigger and softer kernels of many colors, and just plain bigger cobs (84-139 mm in length, with a rachis diameter of 15-25 mm). Pueblo corn (see Table III-17) may be even better adapted than Pima-Papago to the desert conditions of the Southwest and may be the dominant race in historic times there. Unfortunately, the sample we recovered from our excavations was very limited, although other excavations have yielded many more samples that better illustrate the characteristics of Pueblo corn.

Table III-17. Characteristics of Pueblo Corn Excavated in the Jornada Region

Phase	Site	Level	Cat. No.	Kernel Row Number	Avg. Rachis Diameter in mm	Avg. Internodal Length in mm	Index of Condensation
El Paso	Todsen	D		18	20.8	NA	NA
	Todsen	D		16	14.8	NA	NA
	Todsen	D		16	18.8	NA	NA
	Todsen	D		18	16.2	NA	NA
	Todsen	D		14	14.2	NA	NA
	Rattlesnake	1		16	22	3	3.2

NA = not available

Proposed Stages in the Evolution of Corn Races

Table III-18 presents data on the sequence of corn races. Chapalote seems to be the first race in the Southwest, having arrived from Mexico in Early Fresnal times, perhaps before 2000 B.C. Near the end of Fresnal times, by at least 1225 B.C., Galinat believes Proto-Maiz de Ocho had been selected out from Chapalote. During Hueco times further selection and breeding of this race yielded Maiz de Ocho, which became dominant in Mesilla times. However, also evolving, either by selection out of the Maiz de Ocho race in this region or by some unknown process in regions to the west, was Pima-Papago corn, which became even more popular in Ceramic times. In the period of true agriculture after A.D. 1000, the two dominant races, Maiz de Ocho and Pima-Papago, were joined by the Pueblo race that gradually replaced the earlier races. Table III-18 shows the sequence of corn races recovered from excavation.

What do these archaeological facts mean in terms of culture processes in the Jornada region as well as in the rest of the Southwest?

Stage 1. It would seem the initial stage in this process was the diffusion of Chapalote, well before 2000 B.C., to the Southwest from Mesoamerica, where that race had been bred or selected out of wild maize a number of millennia earlier (5000 B.C.) in or near Tehuacán, Pueblo (Mangelsdorf, MacNeish and Galinat 1967). Exactly how, when, and from where Chapalote diffused to the Southwest from Mesoamerica is not fully understood yet, but the present earlier dates for the Jornada region, as well as the later well-used trade route to Casas Grandes and the presence of early Chapalote cobs in the lowest levels of nearby Swallows Cave in Chihuahua, suggest the first diffusion of Chapalote followed a route from somewhere in Zacatecas to central Chihuahua, continuing north to the Jornada region between 4000 and 2000 B.C. (Mangelsdorf and Lister 1956).

This proposed route differs from that through the Sonora highlands to western regions of the Southwest (Haury 1962), where the earliest corn is dated not much before 2000 to 1000 B.C. (Wills 1988; Berry 1982). Whether the diffusion was fast or slow and exactly what was the cultural process of the transmission of corn still is not documented well, but we would speculate it was a slow process and a band-to-band adoption of a supplement to the Jornada people's subsistence system of seasonally scheduled collecting.

Stage 2. The second stage would take place in the general period between 2000 and 900 B.C., that is, during the Fresnal phase, and would involve two processes. The first would be the development of Proto-Maiz de Ocho (the Galinat hypothesis) that saw the "selection for early flowering... as a means to escape from the late season drought, and as a secondary by-product there was a liberation from climatic barriers to a northward spread. Selection for early flowering had correlated responses in reductions to the primitive eight-rowed conditions" (Galinat, personal communication) and a thinner rachis to accommodate larger, softer, and yellower kernels, which basically is the Proto-Maiz de Ocho race.

Table III-18. Sequence of Corn Races from Excavation in the Jornada Region

PHASE	DATE	SITE	COMPONENT	SAMPLE	CHAPALOTE	PROTO MAIZE DE OCHO	MAIZ E DE OCHO	PIMA-PAPAGO	PUEBLO	TOTAL
	A.D. 1350									
El Paso		Todsen	Zone D	cobs			1	1	5	7
El Paso		Roller Skate	Level 1	cobs	1				1	2
	A.D. 1150									
Doña Ana		Roller Skate	Level 2	cobs	2	2				4
Doña Ana		Todsen	Zone D1	cobs		1	1	2		4
Doña Ana		Sonrisa	Level 1	cob	1					1
	A.D. 900									
Mesilla		Roller Skate	Level 3	cobs	4	4				8
Mesilla		Todsen	Zone D2	cobs		2	2	2		6
Mesilla		Tornillo	Zone A1	cobs			1	3		4
	A.D. 250									
Hueco		Roller Skate	Level 4	cobs	2		1			3
Hueco		Roller Skate	Level 5	cobs		2	2	1		5
Hueco		Roller Skate	Level 6	cobs		2		1		3
Hueco		Tornillo	Zone A	cobs	3	2	1	1		7
Hueco		Roller Skate	Level 7	cobs	2	4				6
Hueco		Roller Skate	Level 9	cobs	2	2				4
Hueco		Knee Pad	Level 1	cobs	3					3
Hueco		Tornillo	Zone B	cobs	3	3				6
Hueco		Knee Pad	Level 2	cobs	6					6
Hueco		Sonrisa	Level 6	cob	1					1
Hueco		Knee Pad	Level 3	cobs	2					2
Hueco		Knee Pad	Level 4	cob	1					1
Hueco		Knee Pad	Level 5	cobs	1	1				2
Hueco		Todsen	Level E1	leaf						1
	850 B.C.									
Fresnal		Fresnal	Zone C	kernels	x	x				2
Fresnal		Tornillo	Zone C	cobs	1	1				2
Fresnal		Tornillo	Zone D	cobs	4	4				8
Fresnal		Fresnal	Zone C2	kernels	x					1
Fresnal		Fresnal	Zone F	cobs	3					3
Fresnal		Keystone	Zone 2	pollen	?					?
	2600 B.C.			Total	45	31	9	11	6	103

We believe the second process that occurred in the later part of this stage was the relatively rapid diffusion of both Chapalote and Proto-Maiz de Ocho to the rest of the Southwest, with one corn going north along one route to the Chaco area by 1700-1600 B.C., while other corn went westward to the subareas of the Mogollon (Bat Cave et al.) and Hohokam (Cienegas Creek route et al.) at a slightly more recent date (1200-800 B.C.).

Stage 3. The third stage–roughly 900-300 B.C.–would see the final development of Maiz de Ocho, which, according to Galinat, "is apparently the result of recombination between Proto-Maiz de Ocho and a cobbed form of Chapalote. . . . The sg1 and sg2 genes required could have been selected as variants within the eight-rowed populations but it seems probable that they came through hybridization and recombination with high kernel-row number corn" (Galinat, personal communication). This selection for larger kernels with the concomitant early flowering that came about because of increased time necessary to fill the larger kernels also saw increased rachis diameter and larger cobs to hold the larger kernels as well as more variation in kernel color. Maiz de Ocho now was adapted admirably to the arid Southwest, with its spatial and temporal adaptation to limited precipitation, unreliable annual rainfall patterns, and shorter growing seasons caused by temperature limitations. Whether the initial development of the race took place in the Jornada region, in many regions of the Southwest, or in the Anasazi region in the White Dog phase that had increasing proportions of this race still is not decided, but we favor the last hypothesis.

Stage 4. The fourth stage, occurring some time between 300 B.C. and A.D. 500, saw the further spread of this race (perhaps even to the Eastern United States, as suggested by Galinat and Gunnerson in 1963), as well as the appearance of Pima-Papago corn in the Jornada region. Exactly how and where it developed is not documented well, but we suspect it was not in the Jornada region. True agriculture seems to have developed with these corn types in the Anasazi and Hohokam areas, but did not occur in the Jornada and perhaps the Mogollon until still later, perhaps by other processes and for other reasons.

The final stage–Puebloan times, A.D. 1000-1350–in the Jornada region as well as elsewhere saw the dominance of the larger, more productive, and more color-varied Pueblo race of corn. How and where it developed is not understood well, but our evidence suggests its development probably did not occur in the Jornada region.

The new corn data and dates from the Jornada region of the Southwest have added data about the earlier stages of the development of maize. These data are at some variance with popular concepts that corn arrived late and spread rapidly, along with agriculture, in the Southwest (Ford 1981; Minnis 1985; Berry 1982; Huckell and Huckell 1988). Furthermore, our data call into question the Haury version that has the route of corn coming in through the highlands in the western part of Mexico and the Southwest. Although we still need more data to confirm our hypothesis about the culture processes involved in the development and spread of corn, the data we do have allow us to set up some new hypotheses. These data may not change the minds of our colleagues, but they should at least cause them to re-evaluate their hypotheses as well as set up new research programs to test their hypotheses and ours more adequately.

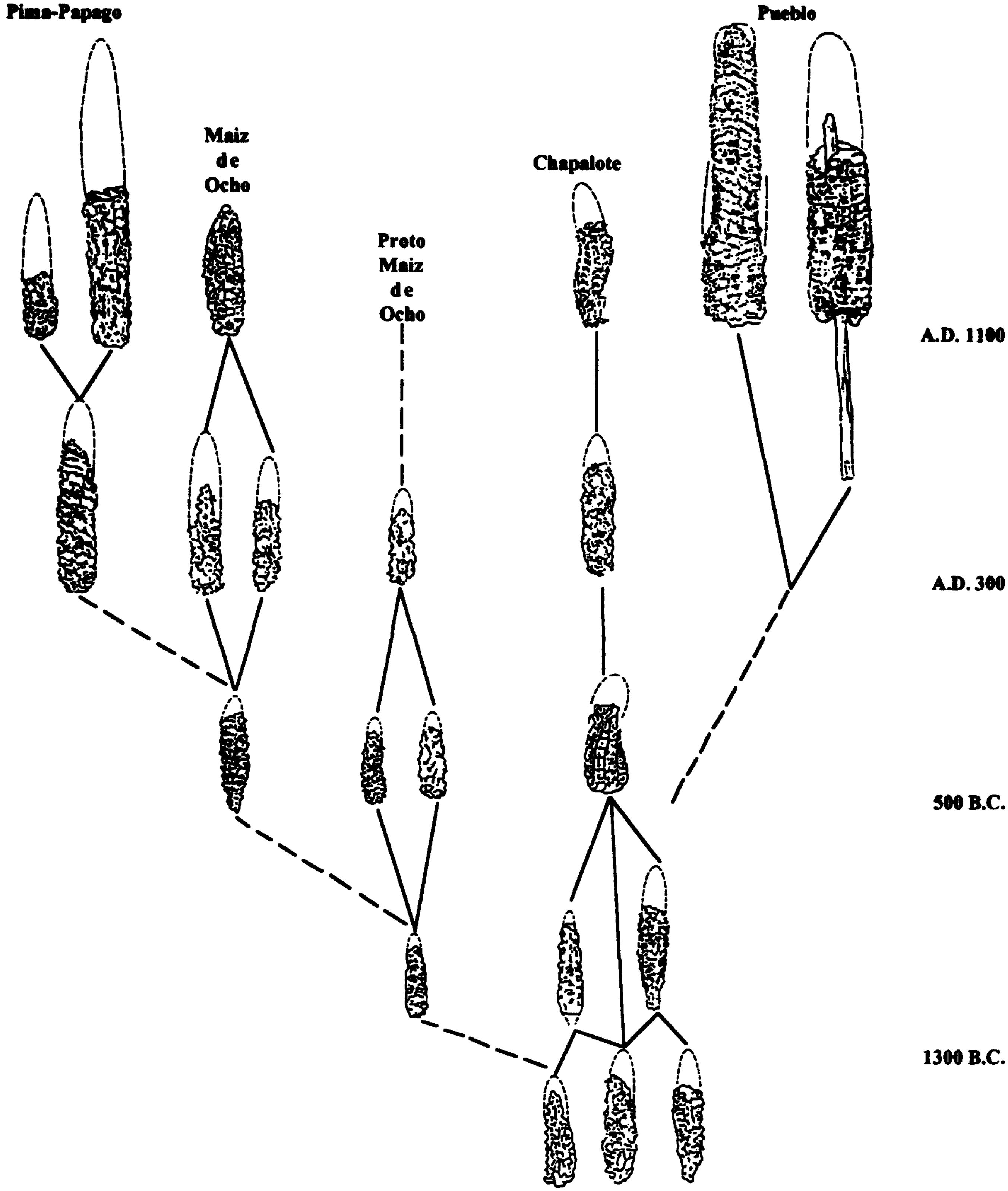


Figure III-21. Sequence of Corn Races in the Jornada Region

Section 4

Carbon 13/12 and Nitrogen 15/14 Isotope Ratios in Skeletons from the Jornada Area

R.S. MacNeish and Bruno Marino

The use of stable isotope ratios of carbon and nitrogen derived from bone collagen to provide estimates of diet has been the subject of numerous studies (DeNiro 1987). The cornerstone of the stable isotopic approach is based on the fact that foodstuffs of dietary importance, such as maize, beans, and marine animals, have different isotopic compositions that are passed on to the consumer (DeNiro and Epstein 1978). In the New World, timing of the introduction of maize, a plant with the C4 photosynthetic mode and high concentration of C13, into a diet consisting primarily of plants with the C3 photosynthetic mode and low C13 has been studied in several spatial and temporal contexts (Schoeninger et al. 1983).

These studies, however, have not attempted to use isotopic data to test specific hypotheses aimed at elucidating the mechanisms and factors responsible for the transition to full-time maize agriculture. This section discusses the carbon (C13/12) and nitrogen (N15/14) isotope ratios of a series of skeletal remains from the Jornada region of the Chihuahua Desert, spanning the period from 2600 B.C. to historic times. This study provides new evidence for the timing and causes of the adoption of full-time maize agriculture and underlines the difficulty of using carbon isotope ratios to infer the dietary use of maize in an ecological setting containing indigenous, nonmaize C4 plants.

Techniques

Before discussing the experiment with the Jornada skeletons, let us describe the techniques used in our study. The process involves the analysis of the collagen in human bone. From the food one eats the collagen absorbs traces of various elements with their stable isotopes. An isotopic study of the bone of human skeletons thus may yield information not only about ancient diets, but also about the proportion of domesticated plants to wild ones in the food people ate, which has implications for evidence about the use of agriculture versus the collecting of wild foods.

One element with isotopes that reflects various kinds of food is carbon; the proportion of carbon 13 to carbon 12 reflects the proportion of C4 plants (that is, seed plants) to C3 plants (leafy plants, roots, fruits, and the like) as well as to CAM plants (some legumes, algae, microorganisms, and so on). The C13/12 ratio also may reflect the kind of seed plant–whether agricultural or wild–and the proportion of terrestrial animals (that were eating either C3 or C4 plants) to vegetal foods in the human diet.

The other element useful in the study of human diet is nitrogen and its isotopes N15 and N14. Marine or aquatic animals have higher N15/14 ratios than do terrestrial animals, while both of these are higher than those of C3, C4, and corn plants, which in turn are higher than those of most legumes. An isotopic study of a chronological series of human skeletons thus may reflect shifts in the proportion of agricultural plants to other food consumed, information that may provide data on the origin of agriculture.

In the Jornada region of the Chihuahua Desert along the Rio Grande of southern New Mexico, unsolved archaeological problems include when "real" agriculture began. Considerable evidence indicates the use of domesticated plants long preceded Pueblo agriculture. Also, the subsistence of the non-Puebloan Apache, who followed the Pueblo florescence of the twelfth to fourteenth centuries, seemed different from that of the Pueblo diet (here, the El Paso phase). Various authors disagree on the Apache diet, suggesting their subsistence systems were (1) like those of the pottery-making pithouse peoples (Mesilla phase) who evolved into the Pueblos, (2) like those of the early hunter-gatherers of the preceramic Archaic, or (3) different from either of them. To settle this dispute, we need to know whether full-time agriculture began in Pueblo times, in pithouse times, or in the Late Archaic. Only then can we start analysis of the relevant part of the sequence to determine how and why agriculture came into being and make generalizations about the causes of cultural changes.

C13/12 Isotopic Ratios

The 1986-87 excavation of Todsen Cave (LA5531) in the center of the Jornada region yielded eight sequential burials. Recognizing that these burials could provide data that would have bearing on the prehistoric subsistence problems of the Jornada region, the junior author, Bruno Marino, undertook isotopic analysis of the burials, using the facilities of the Department of Earth and Space Sciences and the Archaeology Program of the University of California at Los Angeles.

Burial 8 from zone J, which was dated at 1490 ±80 B.C. (A4563), was associated with Fresnal remains that included minor amounts of Chapalote corn and possible pumpkins *(Cucurbita pepo)*. Nevertheless, the diets of people then seem to have consisted mainly of wild foodstuffs, for the C13/12 reading was -16.5, a diet that fits our expectations of Middle Archaic times.

Burials 6 and 4, from zone J with Late Archaic (Hueco) phase remains, were radiocarbon dated directly at 850 ±80 B.C. (UCR2120) and 600 ±100 B.C. (UCR2120), and their C13/12 radios were -12.6 and -13.3 respectively. These people seem to have had an incipient agriculture subsistence system that included not only Chapalote corn and pumpkins but also Proto-Maiz de Ocho, beans, and possibly amaranth.

Above these remains were four burials (numbers 2, 3, 5, and 7) of cranially deformed Pueblo skeletons in zone D, radiocarbon dated at A.D. 1330-1420. Their C13/12 ratios were 7.4, 7.4, 7.5, and 7.8. Associated cultural remains indicate these people belonged to the El Paso phase (A.D. 1150-1350), which was the apogee of Pueblo culture and agriculture in this area.

Above these remains was an infant skeleton with an undeformed low-headed cranium, apparently intrusive from zone C, which had obsidian dates of A.D. 1625 and 1675, and possible Apache sherds. The C13/12 ratio for this skeleton was -13.1.

Encouraged by these results, in 1987 Marino joined AFAR at its Las Cruces headquarters to collect more skeletons for a more adequate sample. Our first collection for analysis, from Connie Evans of UTEP, was important because it gave us good control of the chronology (Evans 1989); the five skeletons were Piro-Jumano-Manso from the Old Socorro Mission south of El Paso that dated from 1684 to 1824. Evans's studies of the physical anthropology of twenty-some other skeletons–13 of which had been analyzed for C13/12 and N15/14 by Geochron–provided specially selected materials we could use to see if there might be age or sex isotopic variations. We analyzed the following: a 60-year-old male (12-11, burial 31), which gave a C13/12 ratio of -9.6; a 40-year-old female (12-2, burial 22), with a ratio of -10.4; a 20- to 23-year-old adult male (12-3, burial 17), with a ratio of -10.8; a 20-year-old adult female (12-4, burial 5), with a ratio of -11.0; and an infant of undetermined sex (12-3, burial 6), which unfortunately had too little collagen to yield results.

The Geochron reading on nine skeletons gave the following results: burial 24, -9.1; burial 28, -9.5; burial 32, -12.1; burial 33, -9.0; burial 34, -10.4; burial 36, -10.4; burial 37, -11.8; burial 18, -12.3; and burial 20, -13.5. The remarkably similar results of their readings and ours indicate there seems to be no bias in terms of age or sex. It should be noted, however, that their C13/12 calculations are not quite the same as those of the Puebloan skeletons of the El Paso phase, although the racial type is the same; the Piro-Jumano-Manso could be descended from prehistoric El Paso phase Puebloan groups.

Our second major donor, largely through the cooperation of Dr. Thomas O'Laughlin, curator of archaeology, was the Centennial Museum at UTEP. Three of the skeletons they provided came from the El Paso phase, A.D. 1150-1350. Burial 1, which yielded a C13/12 ratio of -8.5, was a female in her 40s from room 1 of Pickup Pueblo northeast of El Paso, where radiocarbon dates range from A.D. 1000 ±90, A.D. 1280 ±90, and A.D. 1330 ±110, suggesting a date of A.D. 1300. A second adult, with a ratio of -8.3, came from Hot Wells Pueblo east of El Paso, a complex that is said to have ranged from A.D. 1270 to 1390. The third skeleton was of an infant with too little collagen to date, from the ruins near Mt. Riley west of El Paso, guess-dated at A.D. 1300 because it had an El Paso Polychrome jar with it.

We also tested some earlier skeletons from the museum's collection. One was a rib of burial 1, a female 13-22 years old from the Late Mesilla phase (A.D. 800-1000) of the Roch site west of Mesilla, New Mexico; like the infant, it contained too little collagen to calibrate. Two other skeletons were from preceramic times, but of different phases, and were difficult to date exactly. One was a male 18-20 years old, found in a crevice just east of the Cosgrove's Ceremonial Cave, in the Hueco Mountains east of El Paso. Associated with it was a Hueco point, suggesting it was of

the Hueco phase (900 B.C.-A.D. 250), which we gave a guess-date of 400 B.C. This skeleton yielded a C13/12 ratio of -12.2. Another skeleton came from Dry Cave in the Guadalupe Mountains of New Mexico, a considerable distance east of El Paso and outside the Chihuahua Desert vegetational zone. It was in a sinkhole deposit; bones above it dated at 3183 ±163 B.P. or 1233 B.C., and some bones below it dated close to 7000 B.C. If the earlier date pertains, the skeleton could be of the Fresnal phase. Its C13/12 ratio, however, was -11.1, a reading that does not fit into our sequence (see Figure III-22). The difference might exist because the individual ate different kinds of nondesert foods in the mountain zone or because it is younger than the associated date. We also tested a fossilized rib that we guessed was of an early date, from Chavez Cave, which yielded a ratio of -21.5.

Our final skeleton was an adult male from Mesilla Dam (LA834) near Mesilla, which had pottery types of the Mesilla phase with it and was radiocarbon dated at A.D. 470 ±90 (Beta 20449). A rib of this skeleton, contributed for analysis by Meeks Etchieson of the BLM (Etchieson 1987), gave a C13/12 ratio of -9.5, and almost identical results were achieved in its analysis by Geochron.

Human Systems Research of Las Cruces contributed four or five other specimens, mainly from El Paso sites, but these had too little collagen for analysis. The same was true of a 360 B.C. San Pedro Cochise specimen from Deming, New Mexico, and a Mesilla phase specimen from the Harris site.

Despite the unusable specimens, we do have 27 specimens, dating from at least 2500 B.C. to A.D. 1824, that have yielded significant preliminary results. The figures we have on animal remains and plants from the Las Cruces area, as well as those from other more general (and less reliable) calculations, seem to indicate C13/12 ratios of -7.5 to -8.5 mean a large proportion of the ancient diet consisted of C4 plants–which could be corn, beans, and other domesticates. Ratios from -9.0 to -12.3 seem to indicate heavy consumption of terrestrial animals (which often were eating C4 or CAM plants). C13/12 ratios of -13.0 to more than -21 would seem to mean a major consumption of C3 plants, which in the Jornada area means mainly wild plants and/or animals eating wild plants (see Figure III-22).

N15/14 Isotopic Ratios

Figures on the ratios of N15/14 seem to show somewhat confirmatory interpretations, but again emphasize the animal rather than the plant part of the diet. Our calculations on aquatic animals from the Las Cruces area, combined with other studies, seem to indicate figures above 10 or 11 reflect large amounts of aquatic animals in a diet, while figures from 10 or 11 down to 5 or 3 indicate a consumption of mainly terrestrial animals. Legumes seem to be represented by figures from 5 or 3 to 0, and clearly are differentiated from a diet of meat. The part of the diet represented by C3, C4, and corn plants, however, ranged from 1 to 10 ratios of N15/14 and often is difficult to distinguish from diets of legumes or terrestrial animals.

Nevertheless, when the carbon and nitrogen ratios are taken together, they provide considerable insight into the diets of the Jornada population from roughly 2500 B.C. to A.D. 1824 (see Figure III-22).

Analysis of Results

The C13/12 results from the isotopic analysis of the four Piro-Jumano-Manso skeletons from Socorro Mission, combined with the Geochron analysis of nine other skeletons, yield figures ranging between -9.1 and -13.5. These figures indicate a diet that falls right on the edge of full-time agriculture. As will be seen, however, the ratios are less than that of prehistoric Puebloans or, for that matter, full-time agriculturists in Tehuacán in Mexico, Ayacucho in Peru, or elsewhere (Farnsworth et al. 1985). We believe the slightly lower figure for the Socorro people is due in part to more use of terrestrial animals, probably sheep, goats, and cattle, and perhaps more use of European grains (wheat and barley), which give slightly lower counts than maize.

This hypothesis is confirmed somewhat by our N15/14 ratios, which range from +9.2 to +12.8, indicating heavy consumption of terrestrial animals. The skeletons analyzed by Marino gave ratios of +11.51 (burial 31), +10.54 (burial 22), +11.14 (burial 17), and +11.7 (burial 5). The skeletons analyzed by Geochron yielded ratios of +9.2 (burial 24), +11.2 (burial 28), +9.9 (burial 32), +9.5 (burial 33), +11.1 (burial 36), +10.1 (burial 37), +10.8 (burial 18),

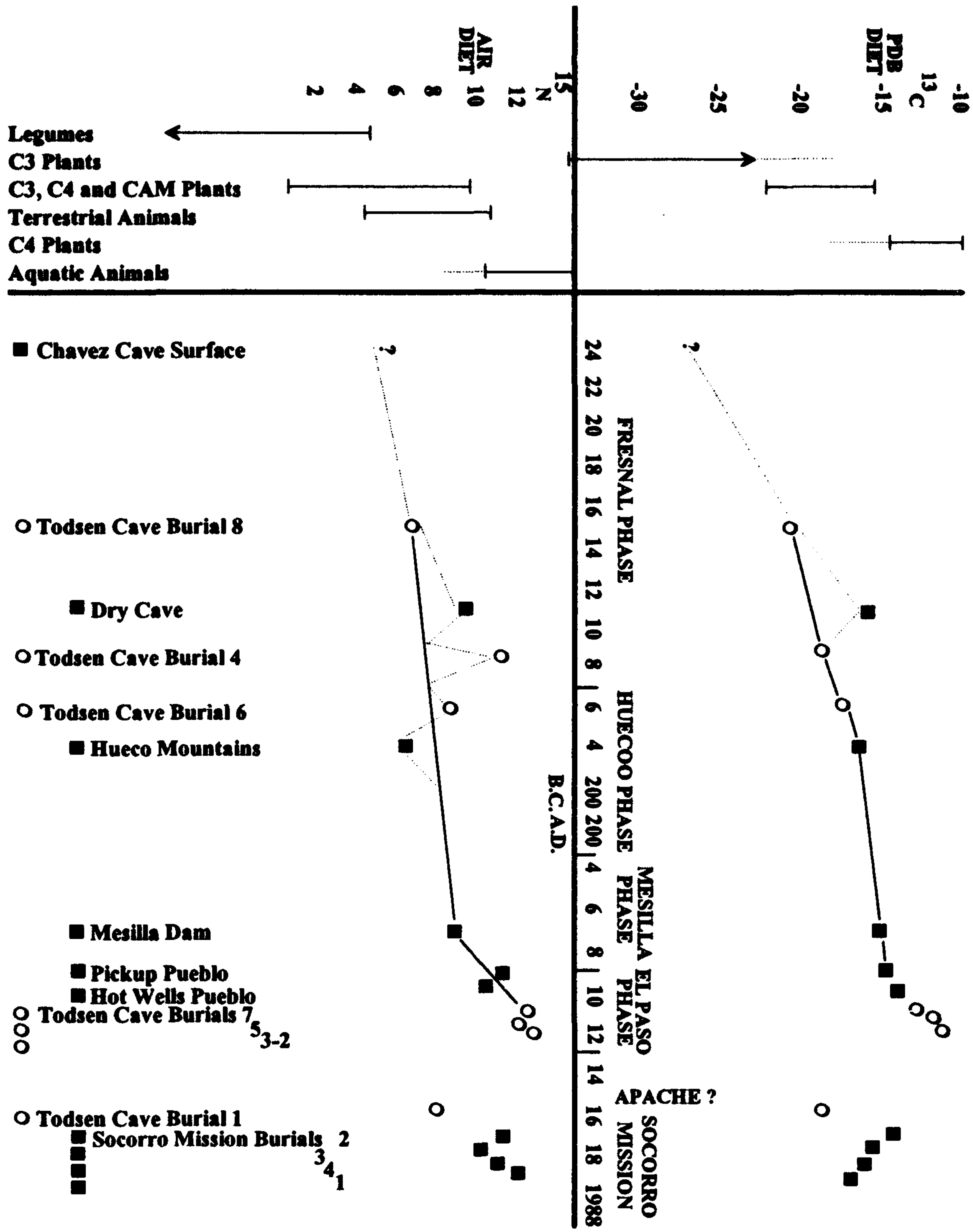


Figure III-22. Nitrogen 15/14 Isotopic Ratios (left) and Carbon 13/12 Isotopic Ratios (right) in Skeletons from the Jornada Region

and +12.8 (burial 12). Of course, distinguishing between domesticated and wild terrestrial animals is difficult; however, the figures for the Socorro Mission people are different from the ones for the prehistoric peoples, who did not have domesticated animals other than the dog, which was eaten rarely judging by studies of their refuse.

The skeleton from zone C of Todsen Cave might be that of an Apache. Its C13/12 ratio of -13.1 is most unlike either the later Piro-Jumano-Manso agriculturists or the earlier Puebloan peoples. In fact, its diet is more like that of the Late Archaic incipient agriculturists of much earlier times. On the other hand, its isotopic N15/14 count of +8.8 differs from the figures for the Archaic peoples and is somewhat like those for the historic peoples. It seems to us that isotopic analysis indicates this skeleton's diet reflects acquisition (theft) of goats, sheep, and cattle from the Spanish population. On the other hand, the Apache could have been involved in more hunting of wild terrestrial animals.

In terms of C13/12, the skeletons of the El Paso phase range from -7.5 to -8.5, representing the diet of typical early agriculturists. Their N15/14 ratios indicate a different story. Todsen burials 2, 3, 5, and 7 have N15/14 ratios of +12.1, +12.2, +7.7, and +12; the Hot Wells burial has a N15/14 ratio of +10.4; and that from Pickup Pueblo has +9.2. In terms of trends, the apogee of agricultural development in Pueblo times fell off during historic times at the Socorro Mission and was totally unlike that of the Apache of the seventeenth century.

The burial from Mesilla Dam has a C13/12 figure of -9.5, just outside the range of agriculturists, leading to the inference that even at this late date (A.D. 470) the people of the Las Cruces region were eating more wild plants than domesticated ones and really were incipient agriculturists like the people of the Late Archaic rather than agriculturists like the Puebloan peoples. The N15/14 ratio, however, is +9, which is like that for the Puebloan peoples. Although our sample for this period is limited, even this one burial hints at a new interpretation of the subsistence development in the Jornada region.

Fitting neatly into these trends are the C13/12 isotopic values—13.3, -12.2, -12.6–for the three Late Archaic (Hueco) phase burials (6 and 4 from zone πJ) from Todsen Cave. The N15/14 ratios were +5, +7.4, and +11.4. These figures do not represent the diet of agriculturists in any sense of the word; however, they do show the people were not living solely on wild C3 plants. In fact, without the archaeological plant data and analysis of local Las Cruces plants, it would be most difficult to determine if the indigenous peoples knew any domesticated plants, let alone if they were incipient agriculturists. Illustrative of this fact is one of our earlier studies of materials from Tehuacán, in which a major decrease of C13/12 values was interpreted as an early use of corn, when in fact it probably reflected an increased use of seeds of another C4 plant, setaria grass. This problem shows how critical it is for isotopic studies to be done within the contexts of local ecology and of evaluations of local plants.

The skeleton from Dry Cave in the Guadalupe Mountains further illustrates these difficulties. First, its C13/12 figure of -11.1 does not fit our trends very well. This ratio could be the result of the person eating fewer C4 plants, or even incorrect dating since we lack a direct radiocarbon date on the skull to place the individual in an appropriate time frame. The N15/14 figure, +12.2, is even more out of line. The Guadalupe area seems to be a region where corn agriculture and seed collecting were difficult because C4 plants do not grow well at such high elevations, so the increase of such in the diet seems unlikely. Taking the local ecology into consideration helps us recognize the possible presence in this diet of quantities of pinyon nuts from C4 plants and abundant mountain animals (sheep, goats, deer).

Although we also need direct dates on our earlier skeletons from Todsen and Chavez caves, they can be interpreted in the framework of an existing analysis of local ecology. Burial 8 at Todsen, which dates from Fresnal times, has a C13/12 value of -16.3 and nearly fits our C13/12 trends that reflect greater consumption of C3 plants and a lesser use of C4 (agricultural) plants. Similar results of -21.5 come from the semifossilized remains from Chavez Cave. The respective N15/14 ratios of +7.7 and +6.1 corroborate the C13/12 figures.

Conclusions

Our C13/12 analysis of the sequential skeletons (excluding that of the possible Apache) indicates a genuine trend toward greater consumption of C4 plants, which points toward increasing agriculture. This study not only allowed us to distinguish between people practicing incipient agriculture and true agriculturists; it also provided a significant basis for better interpreting our reconstruction of ancient diets and subsistence systems.

Although the C13/12 analysis held few real surprises, the results from the N15/14 studies caused some changes in our thinking. On the basis of studies of skeletons spanning a 10,000-year period in Tehuacán, it seemed the amount of

meat in people's diets diminished as agriculture was adopted. We expected the same trends to appear in the Southwest, and were very surprised when our N15/14 isotopic ratios showed just the opposite (see Figure III-22). The results caused us to make a careful re-evaluation of our associated archaeological data, particularly those pertaining to meat in the ancient diet.

The first hint of what was leading us astray came from a consideration of Peggy Wilner's analysis of the animal bones recovered from the stratigraphic levels of Todsen Cave. This study revealed the presence, for the first time, of turtle bones, shell, and fish bones–aquatic animals with high N15 values–in the upper levels (zones D and D1) of El Paso times. The shift to consumption of aquatic resources radically changed the whole trend of N15 values and confirmed our survey data that the riverine ecozone or the ecozones adjacent to it were occupied heavily for the first time during the El Paso phase. Previously, in the Fresnal and Hueco phases, the native people's diet had consisted of terrestrial animals (mainly jackrabbits) with some C3 and C4 plants, including legumes and other plants with low N15 values (between +6 and +9). In Mesilla times, as people moved into the riverine zone of the Rio Grande, their diet shifted slightly toward fewer meat resources and more aquatic ones, culminating in the diets of El Paso phase times that showed N15/14 values between +10 and +12.

In this way our isotopic studies led us to a whole new set of insights into changing diets. They also helped explain the slight drop in N15 values in historic times, a shift resulting from increased consumption of domesticated terrestrial animals along with continued use of Rio Grande resources in the Mission Pueblo. The even greater drop represented by the Apache skeleton seemed to be the result of the lessening consumption of aquatic animals.

The C13/12 and N15/14 studies have opened new vistas for archaeological interpretations. In this specific area of the Southwest they have yielded new data for testing hypotheses and solving specific problems. Yet the technique is not a cure-all for all problems, nor can it be used indiscriminately as a blanket solution for all areas at all times. In fact, analysis of C13/12 and N15/14 isotopic ratios of human skeletons can be used only in conjunction with careful analysis of local animal and plant resources. Our preliminary studies seem to indicate isotopic analysis has great potential for better and more significant interpretations of ancient diets and changing subsistence activities.

Section 5

Organic Residues on Ancient Lithic Artifacts from the Las Cruces Area of New Mexico

Elinor F. Downs

Published reports describing the identification of plant and animal residues on prehistoric lithic artifacts have sparked considerable interest, and also some skepticism (Bruier 1976; Shafer and Holloway 1979; Loy 1983; Lowenstein 1985). Laboratory techniques used in these studies still are experimental, and most of the research focuses on a few selected artifacts, not total assemblages. There is no doubt that under favorable conditions of dryness and protection, plant and animal remains can and do survive for thousands of years on stone tools and can be detected and sometimes identified. However, the frequency of occurrence of these organic finds has not been examined adequately.

The series of studies conducted in the Las Cruces area was designed to help fill this gap, by documenting the occurrence and distribution of adhering residual matter detected on flaked lithic artifacts of several regional assemblages and collections. It was hoped the analytic techniques employed also might be useful in defining the nature and significance of any organic residues found, and in explaining environmental and cultural circumstances influencing their survival.

Methods and Procedures

The methods used to detect and identify the organic residues were developed in an earlier feasibility study (Downs 1985). The techniques employed are inexpensive, simple to carry out, noninvasive, equally applicable to screening individual artifacts or large assemblages, and suitable for use in field laboratory situations.

A preliminary hand-lens scanning of all artifact surfaces provides clues as to the types of residues with which researchers are dealing. The terms *residue, residual material,* and *adhering matter* are used interchangeably to mean any substance sticking to the lithic surfaces, regardless of its form or origin. Residues may range in appearance from overall light coatings of dust with crevice accumulations, flat smudges, raised stains, streaks, and water marks to clumped debris with fibrils or hairs, sand, and fungi. In addition to revealing characteristics of residual material, hand-lens scanning helps identify artifact breakage and signs of use and wear.

A chemical colorimetric test was used as the major screening procedure to detect blood (Lee 1984). It is objective, fast, roughly quantifiable, and extraordinarily sensitive to the presence of blood–but it is not specific. The range of color changes from yellow to dark green is due to a reaction between reagents on a test strip pad containing tetremethylbenzine and a hydroperoxide (these strips are available in pharmacies for use in testing for blood in urine) and the peroxidaselike activity of dissolved blood and certain other soluble substances. An immediate dark green response is presumptive evidence of blood, while no color change unequivocally indicates the absence of blood. Although the colorimetric test clearly distinguishes blood from other color-reacting residue by the speed and intensity of the response, the significance of the slow pale green reactions is less clear. These weak color changes may occur in the presence of certain fresh soluble plant elements, possibly some soluble soil constituents, and incredibly diluted blood solutions (for example, 1:60,000 dilution).

Microscopic examination at 40x-100x magnification focuses on the insoluble matter in residues. Identifiable plant structures may survive for centuries, whereas mammalian soft tissues and blood lose cellular distinctions over time. Animal hairs caught up in residue material readily are distinguishable from plant fibrils. Like plant parts, such hairs sometimes can be identified microscopically as to species. Mineral grains and plant crystals also have their respective characteristic forms, frequently diagnostic.

If blood residue is suspected on the basis of these screening procedures, a drop-sized saline solution of the residue is tested immunologically for species identification, using the Ouchterlony method (Kimball 1983; Lee 1984). This technique is objective and highly specific, but for satisfactory results a basic minimum quantity of material is required for testing.

When applied to individual artifacts, these screening and identifying procedures help locate the residual matter with respect to implement surfaces and edges, and also identify the adhering material as animal, plant, or mineral. When applied collectively to all artifacts in an assemblage, the techniques provide group profiles of the occurrence, distribution, and nature of residual materials.

The New Mexico Samples

The primary focus of the New Mexico studies was Todsen Rockshelter (LA5531), where examination of the entire excavated unwashed flaked lithic assemblage afforded an in-depth perspective on residue patterns at one desert site. A secondary focus of study consisted of informally selected samples of unwashed lithic tools excavated from six Organ Mountain rockshelters, providing a comparative view of residue patterns between similar types of sites in different environments. As a third focus, to give a broader perspective on residue recognition and survival, three dissimilar artifact collections were examined–an unwashed surface survey collection, a well-handled private collection, and a thoroughly cleaned museum collection.

Todsen Rockshelter Assemblage. Thousands of flakes and stones were excavated from the Todsen site during two seasons of excavation (1986 and 1987), and all were left unwashed. Perhaps half (by weight), numbering about 700 lithic specimens, were identifiable as purposely modified tools. These specimens were classified by morphologic style and were grouped into preceramic and ceramic chronologic periods. More than 600 of these identifiable tools were flaked implements, and of this number 552 (about 92 percent) were studied as the Todsen flaked lithic artifact assemblage (see Table III-19). The approximately 80 identified flaked artifacts not included in this sample were, as a group, similar to the study assemblage in style and chronologic period.

Table III-19. Todsen Study Assemblage of Flaked Lithic Artifacts

CHRONOLOGIC PERIOD	TOTAL NUMBER	HAFTABLE POINTED BIFACES	BIFACIAL HAND TOOLS	TERMINALLY WORKED UNIFACES	LATERALLY WORKED UNIFACES
Preceramic	**377**	**62**	**58**	**61**	**196**
1986 Season	85	17	10	16	42
1987 Season	292	45	48	45	154
Ceramic	**175**	**22**	**31**	**27**	**95**
1986 Season	67	10	10	10	37
1987 Season	108	12	21	17	58
Total	**552**	**84**	**89**	**88**	**291**
1986 Season	152	27	20	26	79
1987 Season	400	57	69	62	212

Initial scanning of all the artifacts, visually and with a hand lens, detected few signs to suggest any accumulation of organic material. The surfaces and edges of all 552 artifacts in the study were tested chemically in 2-6 locations each, with special attention given to any stains or clumped debris. No immediate dark green color reactions, indicative of blood, were observed, but 76 artifacts (14 percent) showed slow pale green color responses. The slow color-reacting material from 17 of the artifacts was examined microscopically, and all 17 slides exhibited varying proportions of amorphous plant material with delicate fibrils and fine sandy granules. Epidermal cells of sotol and yucca were identified on three slides. Material from several control artifacts, which had shown no color response to the strip test, showed few plantlike elements microscopically.

These chemical and microscopic findings suggested the residual matter on the artifact surfaces reflected the various plant and sand soil mixes from which the artifacts had been excavated. To explore this possibility, the color-test profile of the unwashed Todsen study assemblage was compared with color-test patterns of 76 unwashed noncultural control stones collected in the various vertical levels and horizontal areas of the excavation from which the study artifacts came. The two profiles were almost identical (see Table III-20); however, artifacts and control stones recovered inside the shelter dripline were far more likely to respond with slow color reactions than those unearthed outside. In addition, it was noted that Ceramic period artifacts gave more frequent slow color responses than implements from the preceramic periods, the latter generally being excavated from deeper levels (see Table III-21). Soil content and environment (that is, moisture and sun) appeared to be prime determinants of the slow colorimetric responses.

Table III-20. Comparison of Todsen Lithic Artifacts and Noncultural Lithic Controls

	TOTAL TESTED	SLOW COLOR REACTIONS	
		NUMBER REACTING	PERCENT REACTING
Todsen Flaked Artifacts	**552**	**76**	**14**
Inside the Dripline	35	11	31
Outside the Dripline	517	65	12
Noncultural Lithic Controls	**76**	**14**	**18**
Inside the Dripline	26	9	35
Outside the Dripline	50	7	14

Table III-21. Color Reactions from Surfaces of Todsen Lithic Artifacts, by Culture Period

CULTURAL PERIOD	TOTAL TESTED	SLOW COLOR REACTIONS	
		Number Reacting	Percent Reacting
Preceramic	292	17	5
Ceramic	108	35	32
Total	**400**	**52**	**37**

On the chance that cultural factors also might have an influence on the color-test patterns, we examined the relationship between color reactions and possible artifact function and utilization. The classification of the Todsen flaked artifacts into four morphological categories, although rough, implied certain differences in their cultural roles. Yet percentages of slow color responses generally were similar for all four groups (see Table III-22).

John Shea of Harvard University conducted use-wear analysis at low-power magnification (40x-100x) on 37 artifacts, all of them excavated from inside the rockshelter dripline. As a group, the 37 specimens were similar stylistically to the total study assemblage, and like the total assemblage, slightly more than half the 37 artifacts were judged to have been utilized. The proportion of slow color reactions among the 37 artifacts was identical for both the utilized and the nonutilized tools. It also was similar to the color responses of 27 noncultural lithic control stones excavated from inside the shelter dripline (see Table III-23). More than 70 percent of the 21 utilized bifaces and unifaces were thought, on the basis of use-wear signs, to have been employed against vegetal material. Yet neither the assigned worked material (vegetal, animal or hard wood/stone), nor the ascribed type of use–such as "drill" and "impact" for bifacially flaked implements, and "scrape," "shave," "saw," and "cut" for unifacially flaked tools–appeared to influ-

ence the color reaction patterns. No correlation could be demonstrated between artifact use and the colorimetric responses.

Table III-22. Color Reactions from Surfaces of Todsen Lithic Artifacts by Morphologic Style

MORPHOLOGIC STYLE	TOTAL TESTED	SLOW COLOR REACTIONS	
		NUMBER REACTING	PERCENT REACTING
Haftable Pointed Bifaces	57	8	14
Bifacial Hand Tools	69	8	12
Terminally Worked Unifaces	62	17	27
Laterally Worked Unifaces	212	19	9
Total	**400**	**52**	**13**

Table III-23. Comparison of Color Reactions of Todsen Lithic Artifacts and Noncultural Lithic Controls

	TOTAL TESTED	SLOW COLOR REACTIONS	
		NUMBER REACTING	PERCENT REACTING
Flaked Artifacts (1986 Season)	37	11	30
Utilized	21	6	29
Not Utilized	16	5	31
Noncultural Lithic Controls (1986-87 Seasons)	26	9	35

While no evidence of blood residue had been found on any of the Todsen artifacts, the possibility remained that some of the slow color reactions we observed might reflect extremely small amounts of residual blood. Use-wear analysis had indicated perhaps 20 percent of the utilized flaked specimens examined had been employed in procuring or processing animals; faunal remains excavated at the site had included deer and rabbit bones. We therefore tested immunologically against rabbit and deer antisera the residues from three artifacts (two unifacial and one bifacial) showing typical slow color reactions. All three residues were negative for both species, suggesting the residues were not blood, or the quantity was too limited for a satisfactory test, or the blood was neither deer nor rabbit.

In summary, laboratory study of the Todsen Rockshelter flaked lithic artifact assemblage demonstrated few archaeological organic residues. No adhering blood could be detected on any flaked specimens. The slow colorimetric test reactions from the surfaces of about 14 percent of both flaked tools and control stones were unrelated to artifact style or utilization, appearing instead to be influenced chiefly by soil and environmental factors. Microscopically, we identified crystals and sand grains, fibrils, and occasional dried structures of common natural plant species, but recognized no cultigens. The evidence all points to the probability that the residues examined and tested originated in the soil, primarily as inorganic and dried vegetal debris, with an overlay of living fungal-type forms.

Organ Mountain Rockshelters. Six rockshelters, located in fairly close proximity to one another in the Organ Mountains, were excavated in 1984 and 1985. Like the desert Todsen site, these shelters were quite shallow, provid-

ing limited protection against rain and sun and showing relatively poor preservation of organic remains compared to the recovery of lithic and ceramic finds. Few classifiable artifacts were retrieved on excavation, the bulk of the lithic material being flakes of various sizes, all left unwashed.

An informally selected sample of 350 lithic flakes was chosen from assemblages of six shelters–Peña Blanca, Tornillo, Roller Skate, Thorn, Rincon, and Knee Pad. The selection was based on visual signs of breakage and adhering residue (see Table III-24). On hand-lens examination many specimens, particularly from Peña Blanca, were seen to be covered with a dark, almost greasy, ashlike dust. Not more than about 20 percent of the flakes showed evidence of use. Colorimetric screening of 154 (44 percent) of the most soiled and broken flakes gave a color-test reaction pattern almost identical to that of the 552 flaked implements from Todsen. No presumptive evidence of blood was found. Microscopic slides prepared from residues on four of the utilized tools showed sand grains and plant fibrils in an amorphous matrix, reminiscent of the Todsen site slides. On the chance that residual material on one scraper might be of animal origin, a species-specific immunologic procedure was carried out, testing the slow color-reacting residue solution against five mammalian species (dog, rabbit, sheep, deer, and human). The results were completely negative.

Table III-24. Color Reactions of Selected Lithic Specimens from Organ Mountain Rockshelters

ROCKSHELTER	TOTAL NUMBER EXAMINED	TOTAL NUMBER TESTED	NUMBER SLOW COLOR REACTIONS
Peña Blanca	141	71	12
Tornillo	97	20	4
Roller Skate	40	19	1
Thorn	38	23	0
Rincon	25	12	1
Knee Pad	9	9	1
Total Number	**350**	**154**	**19**
Total Percent	**100**	**44**	**12**

In summary, the color-test profiles of unwashed lithic specimens excavated from six Organ Mountain rockshelters and the Todsen site were almost identical. No blood was detected. Despite the similarities in color-test patterns, the proportion of utilized to nonutilized flakes was far higher for the Todsen specimens, reinforcing the evidence for poor correlation between colorimetric test reactions and utilization. Residues detected on all these rockshelter implements appear to reflect the natural soil constituents and plant communities of the area.

Regional Collections. Over the years the Human Systems Research Laboratory has conducted numerous field surveys around the Las Cruces area, and has amassed a large collection of surface-collected artifacts. From this collection, 150 unwashed points and scrapers, picked up in 1985 and 1986, were selected informally for hand-lens examination. Of this number, 93 (60 percent) were tested colorimetrically. No evidence of blood was detected, but the proportion of residues giving slow color reactions was relatively high (41 percent). This figure was similar to that of 26 unwashed control stones surface-collected in 1986 (46 percent), and much higher than that of unwashed but excavated artifacts and control stones (about 14 percent; see Table III-25). When examined by hand lens, some of the stains on the surface artifacts appeared to be of fungal origin, and microscopic slides from seven of these residues showed plant or fungal forms. An immunologic identifying procedure on a solution of color-reacting material partially covering one surface of a small point was negative to five mammalian species (dog, rabbit, deer, sheep, and human).

Table III-25. Color Reactions of Lithic Artifacts and Noncultural Lithic Controls from New Mexico Collections

COLLECTION/ ASSEMBLAGE	TOTAL NUMBER EXAMINED	TOTAL NUMBER TESTED	DARK GREEN	PALE GREEN	SLOW COLOR REACTIONS	
					NUMBER REACTING	PERCENT REACTING
Surface-Collected/ Unwashed						
Control Flakes/ Stones	0	26	0	1	11	46
Human Systems Research Lab.	150	93	0	3	35	41
Surface-Collected/Handled						
Prvt. Collection	234	75	1	4	12	23
Excavated/Unwashed						
Control Flakes/ Stones	0	76	0	1	13	18
Todsen	52	552	0	0	76	14
Organ Mountains	350	154	0	2	17	12
Cleaned						
UTEP	186	65	1	1	6	12

For more than 60 years lithic artifacts picked up as casual surface finds in Oklahoma and New Mexico had been saved in a shoe box as a private family collection. An informally chosen sample of 234 of these well-handled points and scrapers was examined with a hand lens, and 75 (32 percent) were selected for color testing because they were stained and appeared to have been used. The proportion of slow color-reacting residues on the well-handled surface artifacts (23 percent) was lower than that on the unwashed surface artifacts (41 percent) but higher than that on the unwashed excavated collections (14 percent; see Table III-25). Adhering material from one small battered biface scraper giving a slow dark green response and from two other artifacts giving slow pale green and negative reactions on the color test showed, on microscopic examination, the usual plant fibrils in a clumped amorphous matrix. A solution of the slow dark-green-reacting residue was negative for five mammalian species on immunologic testing.

In the State Museum at UTEP, 186 carefully washed and curated lithic bifaces from southern New Mexico and Texas were examined by hand lens. Their surfaces were shiny and clean, almost dust-free. Chemical tests conducted on 65 (38 percent) of the specimens gave slow color reactions on only 12 percent of the artifacts (see Table III-25). One broken tool stood out from the rest because of a dirt-stained smear on one surface that registered a slow dark green on the color test. Microscopic examination of this residue revealed only clumped plant fibrils, and an identifying immunologic test proved negative for five mammalian species.

In summary, the three collections differed from one another with respect to their color reaction profiles, the differences generally being commensurate with the circumstances of their artifact recovery methods (primarily surface finds) and with subsequent treatment procedures (unwashed or cleaned). These regional findings support the Todsen Rockshelter observations that environmental and not cultural factors chiefly were responsible for the organic residue patterns seen on lithics collected in the Las Cruces area of New Mexico.

Conclusions

The study of lithic assemblages amply demonstrated the practicality of the laboratory procedures in screening both individual artifacts and large lithic collections. More importantly, the consistency of results obtained made reasonable

interpretations possible. The organic residue distribution patterns revealed in the New Mexico studies showed culturally related animal and plant remains on ancient lithic artifacts can be rare indeed. Failure to detect these remains is believed caused not by limitations of the study methods employed, but by site-specific environmental factors detrimental to organic residue survival over time. Not all archaeological circumstances provide the ideal surroundings necessary for good organic preservation. The open desert and shallow rockshelter sites surveyed apparently did not offer the special conditions of dryness and protection needed.

The major type of organic material found on the flaked lithic artifacts from the unwashed assemblages and collections appeared to be fresh noncultural vegetal forms. Dried plant remains of potential cultural importance, such as sotol and yucca, also were identified from the surfaces of a few ancient tools. However, their age and cultural significance could not be established with any degree of certainty because the same vegetal species found in any ancient surface residue also might occur as a natural ingredient in the soil surrounding the artifact. On the other hand, any blood detected on an ancient lithic artifact would have clear cultural implications because blood does not occur as a natural constituent of soil. However, no blood was detected.

For best results in finding ancient organic residues and interpreting their distribution patterns, certain basic conditions of deposition, disposition, and survival are required. The residue must have been deposited on the artifact in some quantity as the result of human activity. The artifact must have been disposed of in an environment/soil free from moisture and protected from the elements and taphonomic disturbances. When found, the artifact must have been left unwashed in as dry an atmosphere as possible, and the residue guarded from handling.

Section 6

Use-Wear Patterning on Expedient Tools

Peter Dawson

This study was undertaken to infer the functions of a variety of lithic implements, recovered from the Spring Canyon and North Mesa localities, through the replication of a series of actions imparted on a collection of different organic and inorganic materials. We attempted to provide data that would support the hypothesis that specific actions imparted on specific raw materials will produce fixed and predictable use-wear patterns. Such patterns then could be used as a standard for comparison in the identification of use-wear patterning occurring in the archaeological records of the Todsen and North Mesa sites.

Method

To provide data, we knapped a series of "expedient" flakes from cores of rhyolite, a local raw material that frequently appears in the archaeological record at North Mesa and Todsen. A collection of different raw materials, both organic and inorganic and of varying degrees of hardness, was gathered to test use-wear patterns. MacNeish defined a series of actions on the basis of the raw materials' relationship to subsistence and related activities. Flakes were selected randomly and each defined action was performed as a task on each of the selected raw materials.

Finally, we examined microscopically the utilized or worked edge of each tool (expedient flake) to detect possible use-wear patterning, using the following replication equation:

(Action + Raw Material) x Duration = Task

The following factors were held constant during the experiment:

1. Indiscriminate selection of flakes with respect to task and raw material
2. Raw material (rhyolite) used as a medium for tool production
3. Number of actions performed per task–50 and 100 strokes along two different edges of the tool, respectively

The edge angle and size of the flake in relation to the action and raw material was not kept constant. Edwin Wilmsen's studies of Paleo-Indian lithic tools used for working hide and wood suggest the more acute the edge angle, the more suitable the tool is for hide scraping and associated butchering activities (Wilmsen 1973). Conversely, the steeper the edge angle, the more suitable the tool is for scraping, shaving, and similar activities on harder materials such as wood and fibrous plants (Cantwell 1979). Tool size also can relate directly to handling ability and control, since smaller implements (if not hafted) are more difficult to control when used on greasy bone or wet organic material such as agave.

Flakes were selected indiscriminately and randomly to reduce experimental bias associated with the projection into the past of my speculative criteria as to what characterized a particular flake as an efficient task-specific tool.

Actions were classified as either *static* (pressure) loading, or *dynamic* (percussion) loading of the working edge of the tool, as follows:

Static Loading	Dynamic Loading
cutting	adzing
sawing	chopping
incising/engraving	projectile impaction
slicing	drilling
shaving	pecking
scraping	grinding

By static loading, I mean the application of the force of pressure to the working edge of the tool. Dynamic loading is the application of percussive or impact force to the working edge of the tool.

Descriptions of use-wear motions included the angle of contact, that is, the angle formed between the utilized edge of the tool and the surface being worked. Some of the movement was bidirectional (done in two opposing directions), some movement was unidirectional, and some was birotational, that is, clockwise/counterclockwise movement in which the point or spur of a tool is rotated.

Raw materials used in the experiment were classified subjectively as being *hard, medium,* or *soft* in consistency:

1. Hard ...... stone, hard wood, dry bone, shell
2. Medium ... soft wood, wet bone, hard fibers
3. Soft ...... agave, leather, meat, grass

Key to Use-Wear Patterning

Following is a preliminary key to identification of use-wear patterning on rhyolite flakes, based on the experimental data. Diagrams illustrate each process.

Adzing. Application of unidirectional dynamic loading of the working edge of the tool at an angle of contact acute to the surface being processed. The combined vectors of force (force of impact + coefficient of friction of the working edge against the raw material) produce, on hard and medium material, a series of step and/or hinge fractures along one side of the working edge. This step fracturing tends to occur on the side of the working edge facing the raw material. Softer materials, such as agave, leather, and grass, tend to produce a slight polish on both sides of the working edge. If such soft material is being processed on a hard platform or surface, a misdirected blow may produce one or more step fractures along the working edge, but unless this is a frequent occurrence, I feel that such fractures should be infrequent, isolated along the edge, and therefore identifiable.

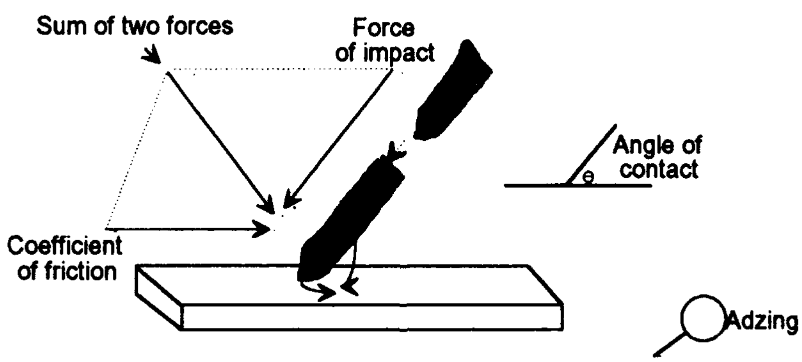


Figure III-23. Unidirectional Dynamic Loading–Adzing

Chopping. Application of unidirectional dynamic loading of the working edge of the tool at an angle of contact perpendicular to the surface being processed. The combined vectors of force produce step fractures along both sides of the working edge of the tool. Because the force of impact is perpendicular to the surface being worked, there is an equal chance that a step and/or hinge fracture will occur along either side of the tool's working edge on hard and medium materials. As in adzing, softer materials will tend to produce a polish along both sides of the working edge. Also, if the material is being processed on a hard platform, a misdirected blow may produce one or more step fractures

along the working edge, but as in adzing, such fractures should be infrequent and isolated along the working edge, and therefore easily identifiable.

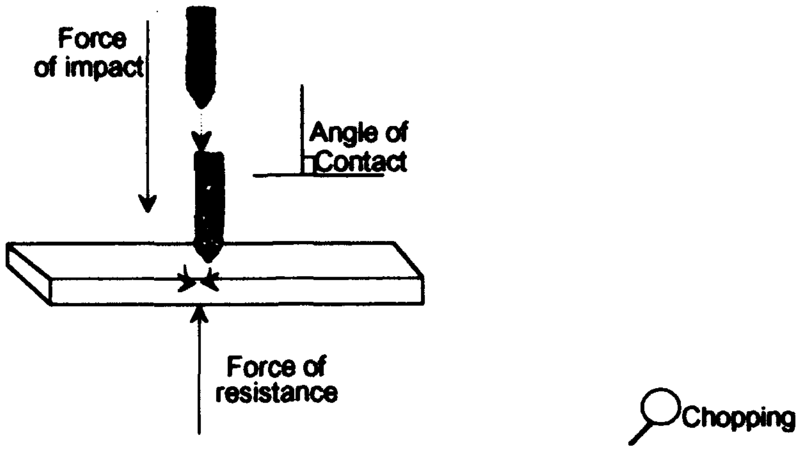


Figure III-24. Unidirectional Dynamic Loading–Chopping

Scraping. Application of bidirectional static loading of the working edge of the tool at an angle of contact acute to the surface being processed. The combined vectors of force produce step/hinge fractures on both sides of the working edge. The step/hinge fractures produced during the power stroke, however, usually are more pronounced and definable than those produced during the return stroke since the coefficient of friction has been reduced (see diagram). This holds true for most hard and medium raw materials, with the exception of wet bone, since bone grease often acts as a lubricant, thereby reducing the coefficient of friction that exists between the working edge of the tool and the surface of the material. In such instances, step fracturing should be rare; instead, polish or raw material residue appears to be an appropriate diagnostic indicator for identifying scraping. This polish should be most pronounced on the side of the working edge facing the surface of the material undergoing processing.

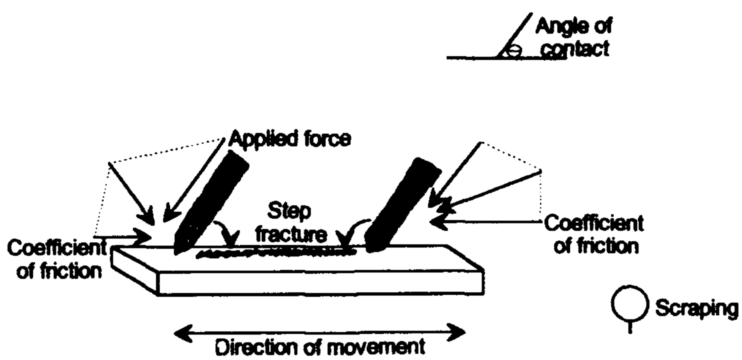


Figure III-25. Bidirectional Static Loading- Scraping

Shaving. Application of unidirectional static loading of the working edge of the tool at an angle of contact acute to the surface of the material being worked. The combined vectors of force produce step fractures along one side of the working edge only–the side facing the surface of the hard and medium raw materials being processed. Soft materials tend to produce a polish and/or organic residue on both sides of the working edge. The side of the working edge of the tool facing the raw material surface should show more pronounced polish and/or residue. Bone grease and wet organic materials also reduce the coefficient of friction between the working edge of the tool and the raw material surface, thereby reducing the likelihood of step fracture occurrences.

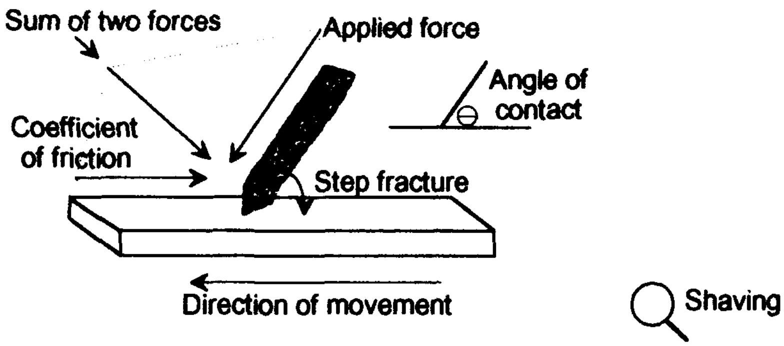


Figure III-26. Unidirectional Static Loading–Shaving

Sawing. Application of bidirectional static loading of the working edge of the tool at an angle of contact perpendicular to the surface of the material being processed. The combined vectors of force are applied longitudinally, or along the length of the working edge. This motion produces a series of bidirectional overlapping striations, and polish along both sides of the working edge in the case of hard wood and dry bone. With hard raw materials such as stone, sawing will grind the working edge flat. It is important to note that the coarseness of the working surface and the smoothness of the working edge are two variables that often will produce intermittent step/hinge fractures on both sides of the working edge.

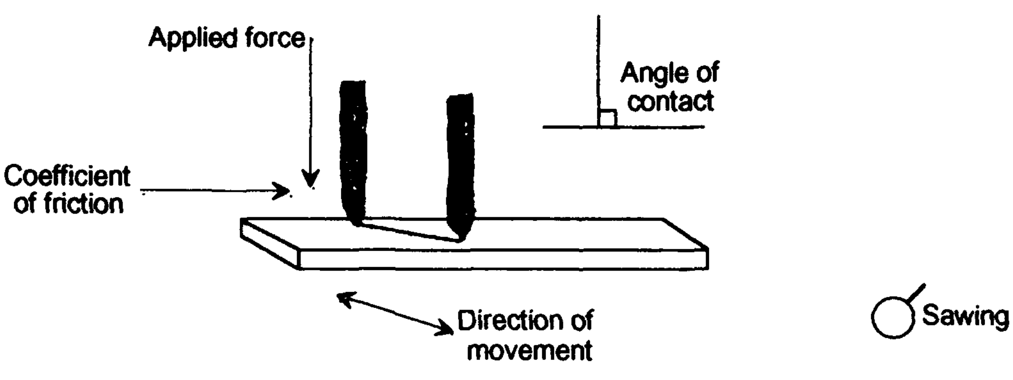


Figure III-27. Bidirectional Static Loading–Sawing

Cutting. Application of unidirectional static loading of the working edge of the tool at an angle of contact perpendicular to the surface being worked. The combined vectors of force are applied longitudinally, or along the length of the working edge. This motion produces a series of unidirectionally angled striations along both sides of the working edge in the case of medium and hard organic and inorganic materials. Softer materials, such as soft wood and agave, will tend to produce a polish on both sides of the working edge. Hard stone will tend to grind the working edge flat. As with sawing, it is important to note that the coarseness of the working surface and the smoothness of the working edge are two variables that often will produce intermittent step/hinge fractures along the working edge.

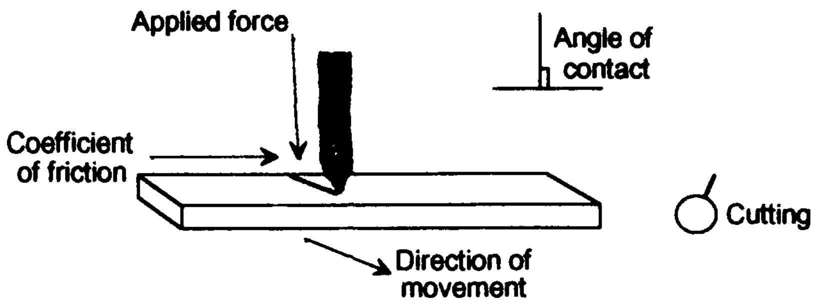


Figure III-28. Unidirectional Static Loading–Cutting

Slicing. Application of unidirectional static loading of the working edge of the tool at an angle of contact acute to the surface being worked. Hard and medium raw material surfaces tend to produce unidirectional striations along one side of the working edge. Soft raw materials, in contrast, produce a slight polish plus organic residue along one side of the working edge. As with sawing and cutting, the coarseness of the working surface and the smoothness, or flatness, of the working edge are two variables that can produce intermittent step/hinge fractures on the side of the working edge facing away from the working surface.

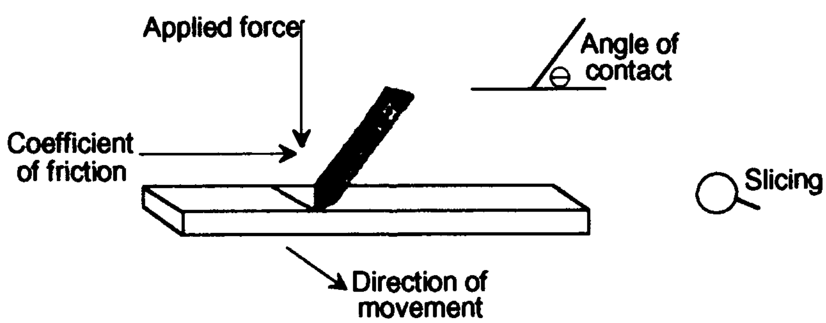


Figure III-29. Unidirectional Static Loading–Slicing

Incising/engraving. Application of unidirectional static loading of the working edge of the tool (usually a "point" or "spur" on the flake) at an angle of contact acute to the working surface. Hard and medium raw materials, such as stone and hard wood, produce an initial fracturing of the point or spur. With stone, this initial fracturing is followed

by the grinding down of the broken surface to a flat nub. Softer materials may (or may not) produce a fracture of the point or spur, but usually will produce a slight polish with traces of raw material residue in and around the working edge/point of the tool. It is important to note that the coarseness of the working edge and the length-to-width ratio of the point/spur can produce fracturing of the pointed edge of the tool on a wide variety of hard and soft materials.

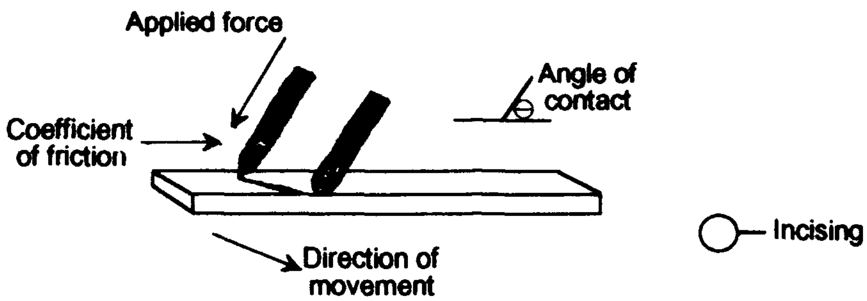


Figure III-30. Unidirectional Static Loading–Incising/Engraving

Projectile impacting. Application of unidirectional dynamic loading of the working edge or "point" of the tool at an angle of contact highly variable. The angle of contact is influenced by both the position and distance of the target with respect to the "launch site." For the purposes of this experiment, however, the angle of contact was held constant, that is, more or less perpendicular to the intended target surface.

A projectile launched at hard material, such as stone, will produce a complex step fracture, which is the result of the percussion of impact driving off the point of the flake. Soft materials, such as agave, tend to produce slight polishes plus traces of organic residue around the impacted area of the flake. Again, it is important to note that the angle of contact, force of impact, and the length-to-width ratio of the point are variables that can influence the complexity of the break.

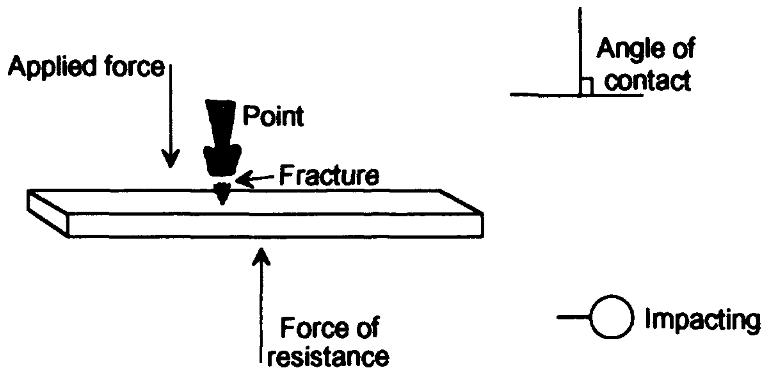


Figure III-31. Unidirectional Dynamic Loading–Projectile Impact

Drilling. Application of birotational static loading of the working edge (point or spur on the flake) at an angle of contact perpendicular to the surface being worked. Hard inorganic materials, such as stone, tend to produce an initial series of hinge fractures on the point or spur. These hinge fractures are produced as a result of the combined vectors of

vertical static force and birotational torque or twisting force. Hinge fracturing of the point of the tool is influenced indirectly by the length-to-width ratio of the point, and such fracturing usually is followed by grinding of the point into a flattened platform. Hard organic materials, such as wood or dry bone, tend to produce initial hinge fractures followed by striations, polish, and organic residue around the circumference of the working edge. Wet bone tends to produce few hinge fractures because the animal grease present in and on the diapysis acts as a lubricant and substantially reduces the coefficient of friction existing between the point of the tool and the working surface. As a result, wet bone and soft materials, such as agave and hide, tend to produce an organic residue and polish around the circumference of the working edge or point.

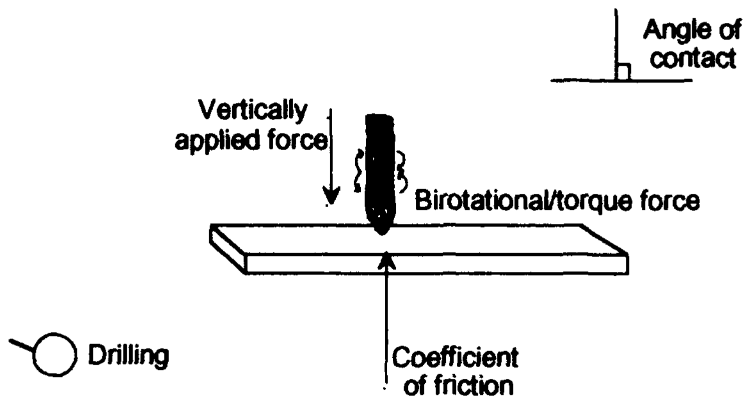


Figure III-32. Birotational Static Loading–Drilling

Pecking. Application of unidirectional dynamic loading of the working edge or point of the tool at an angle of contact perpendicular to the surface being worked. With hard inorganic materials, such as stone, the dynamic or impact loading of the point or spur of the tool produces hinge fractures and/or step fractures around the working edge. Each strike or blow appears to flatten out the spur or point, thereby creating a form of striking platform. Subsequent blov

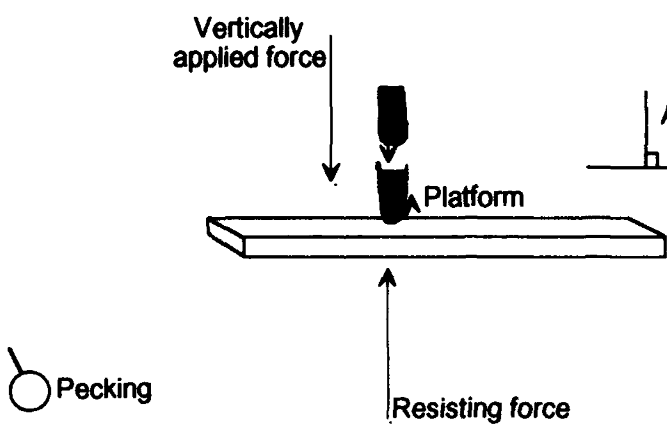


Figure III-33. Unidirectional Dynamic Loading–Pecking

blows will drive off more chips and produce more fracture scars. Hard organic materials, such as wood, and all raw materials of medium and soft consistency were observed to produce organic residue and a slight polish around the circumference of the working edge. No step or hinge fracturing was observed on such material. It is important to note that if materials of medium and soft consistency were processed on a hard platform, a misdirected blow could produce hinge/step fracturing of the working edge of the tool. Again, any fracturing of the spur or point of the tool is influenced indirectly by its length-to-width ratio.

Grinding. Bidirectional static loading by an object at an acute or horizontal angle to the surface being worked makes oval or straight striations on the hand stone and receptacle being worked.

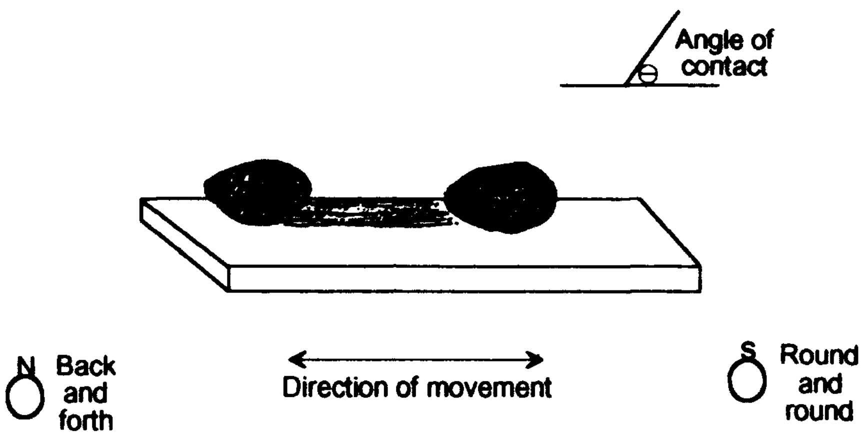


Figure III-34. Bidirectional Static Loading–Grinding

Summary

The Preliminary Key developed in this article is the result of both inductive and deductive reasoning and is derived, in part, from the following equation:

(Action + Raw Material) x Duration = Task

Action: Constant

Raw Material: Hard (Coarse, Smooth); Medium (Coarse, Smooth); Soft (Coarse, Smooth)

Duration: 50, 100

In this equation, *Task* is equated with use-wear patterning in that it represents a physical manifestation of the task, that is, physical evidence of residue left behind after the completion of a task. *Action* is considered a constant, while *Raw Material* is a variable and is broken down into the categories displayed in the preceding dendogram.

The following paragraphs summarize my findings.

1. Dynamic actions imparted on hard materials produced the most dramatic and observable patterns of use-wear, which also appeared to be somewhat fixed and predictable (for example, hinge and step fracturing along the working edge).

2. Static actions imparted on hard materials with smooth surfaces produced use-wear patterns that were somewhat fixed and predictable (for example, hinge and/or step fractures or striations).
3. Static actions imparted on hard materials with coarse surfaces produced dramatic and observable use-wear patterns that were irregular and unfixed (for example, hinge and/or step fractures or striations).
4. Dynamic actions imparted on medium and soft materials produced no real observable hinge or step fracturing. Instead, polish and/or organic residues were present.
5. Static actions imparted on medium and soft materials with smooth surfaces produced no real step or hinge fracturing. Instead, polish and/or organic residues were present.
6. Static actions imparted on medium and soft raw materials with coarse surfaces sometimes produced irregular and unfixed hinge and/or step fractures. Usually, however, polish and/or organic residues were present.

The above observations and inferences are subject to certain limitations. Many variables can affect edge performance and use-wear behavior and therefore must be considered by the lithic analyst in interpreting data. Unusual edge-angle morphologies often can influence the spatial positioning and number of flakes removed from the working edge of a tool when it is being used. The use of a tool for a number of different and completely unrelated tasks also can undermine analysis and can result in overlapping use-wear patterns.

Recommendations

Further research should focus on increasing the duration component of the replication equation. It is my opinion that an increase in duration might make fixed and predictable use-wear patterning more readily observable. A major problem in this experiment was that use-wear patterning was extremely difficult to observe. I often was forced to generalize from a limited knowledge of fracture mechanics and other observations recorded throughout the experiment.

A sample or population of tools should be produced to be used in individual actions on specific raw materials–for example, 10 flakes per task. Redundant use-wear patterning then could be identified and verified more readily.

Chapter IV

CHRONOLOGY

The chronology of the Archaic is fundamental in our research design. This major contribution of the Andover Foundation research program in the period from 1984 to 1989 is the first step in attacking the larger problems of the origin of agriculture and village life in the Southwest.

In this chapter basic chronology is considered from two standpoints, relative and chronometric. The relative chronology in large part is based upon artifacts in their stratigraphic sequence. The following pages present a sequence of types that reflect the sequence of culture complexes or phases we hope to study to find out how and why changes that led to early agriculture occurred. The study of artifacts, the fundamental part of ancient material culture, not only illustrates some basic changes, but provides data other researchers use in their studies.

For convenience, we have divided the lengthy descriptions of artifact types into sections covering relatively related artifacts–projectile points, nonhaftable bifaces, terminally worked unifaces, laterally worked unifaces, ground and pecked stone tools, bone and shell tools, perishable artifacts, and ceramics.

This discussion supplements the interdisciplinary studies on associated plant, animal, and skeletal remains and will form the basis for the chronology of culture phases described in our conclusions.

In addition, we are including various kinds of chronometric evidence–radiocarbon determinations, obsidian hydration, and cross-dating–to provide more exact chronology. This basis of relative and absolute dates allows us to turn to contextual studies that reconstruct the way of life followed by peoples of particular periods, which provides insight into the problem of culture change.

Part A: Relative Chronology

Section 1

Projectile Point Typology

The objects most sensitive in reflecting cultural change in our excavation of Todsen Cave (LA5531) as well as the nearby North Mesa site (LA5529) were the so-called projectile points–or more precisely, in a morphological sense, the chipped, pointed, haftable bifaces. Such bifaces have been exhumed and recognized for almost a century in the Southwest, but only occasionally have they been classified into types and adequately described. Even when typed, the various attributes and terminology have not been defined adequately in this area, in contrast to what has been done in adjacent Texas and northern Mexico, Oklahoma, and California. This chapter is an attempt to fill the void; we believed we could not define our sequential cultural phases or cultural relationships adequately without the use of a typology.

We have defined artifact types as "groups of artifacts with mode clusters–that is, a series of interrelated features of attributes having significance in time and space" (MacNeish 1967). As time and space markers, artifacts to some degree represent concepts of special styles or modes in the minds of their makers. This idea is based on a series of simple assumptions about culture (Ford 1962).

1. Culture is a continuum of interrelated concepts, ideas, and beliefs through time and space. In other words, any group of people living at a particular time and in a specific place received a set of concepts, ideas, and beliefs from their predecessors and ancestors. What is more, their culture (or that of their ancestors) always has been influenced by the culture of peoples surrounding them. Further, the culture of this particular group at this time and this place will be passed on to future generations.
2. Culture is changing constantly, owing to a variety of cultural mechanisms. This change may show considerable variation, both as to the particular aspects of the culture that may change and in regard to the speed and rate of change.
3. Culture both patterns and gives consistency to custom behavior. In other words, culture has an internal order. At any one moment in time, a culture will have a certain core of ideas and beliefs about what is the "right" way to make a pot or tool, and this "right" way will appear to the maker as consistent with the other aspects of his/her culture and environment. "Artifacts are reflections of culture. As such, they are part of the cultural continuum, are constantly changing, and reflect the internal order of a culture." (MacNeish 1967).

Attribute Cluster Method

In order to determine whether mode attribute clusters do exist for the haftable bifaces (projectile points) found in Todsen Cave and the North Mesa site, it first was necessary to define our terms, basically the attributes, that make up the attribute clusters, and then, by statistical analysis, to determine whether a sufficient commonality existed among the various points so they could be grouped into cultural phases. As a further step, we used our data to assign the points to the Todsen and North Mesa cultural phases already determined.

In developing our set of attributes, we used and expanded upon the terminology of Bell (1960), Turner and Hester (1985), MacNeish and Irwin (1962), and others.

We do not believe our terminology is perfect, or that it covers every possibility; however, it does serve to define the specific attributes we believe important in the Southwest United States, thereby providing readers with a basis for understanding our methodology.

Orientation

We viewed chipped, pointed, haftable bifaces from two basic orientations: an end-view orientation and a top- or bird's-eye-view orientation.

In the basic end-view orientation (see Figure IV-1) the most convex chipped surface is considered the *dorsal* surface, and the flatter surface (which is placed downward in measuring) is the *ventral* surface. The junctions of the dorsal and ventral surfaces are considered the *edges,* the right and left edges defined by the above orientation.

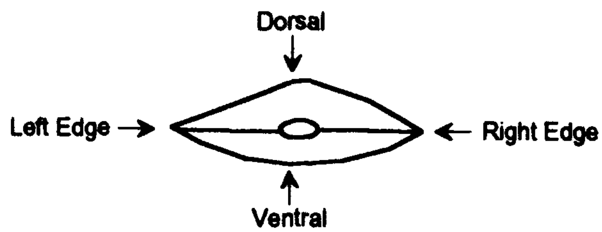


Figure IV-1. End-View Orientation Attributes

The second orientation, or the top view of the object, is shown in Figure IV-2. For measurement purposes, the biface is placed as shown on a flat surface with the flatter (ventral) surface on the bottom. Note that the object has a *distal* end (the tip) and a *proximal* end (the base) and that it has eight basic parts: tip, edge, body, shoulder, notch, stem, basal junction, and base. Figure IV-2 shows the various parts of a projectile point. Placement of the object as shown defines the left and right edges. The *tip* is the pointed or distal narrowest end. As the distal end, it is oriented farthest from the recorder.

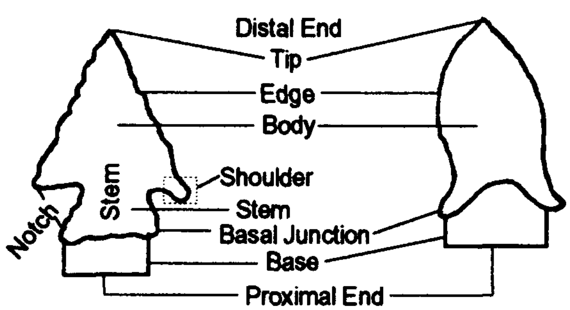


Figure IV-2. Top, or Bird's-eye Orientation

Projectile points may be stemless or stemmed, but in either case they all have a *body*, the portion extending back from the tip. On stemless points, the body extends from the tip to the base, while in stemmed points, the body extends from the tip to the *shoulder*, which is the first major break in the edge contour above the base. This break in contour often is caused by chips being removed from the edge just above the base. The concavity of the removed region is called the *notch.* That portion that extends from the deepest part of the concavity of the notch to the base is the *stem.* The junction of the base with the stem edges (in a stemmed point) or the junction of the base with the body edges (in a stemless point) is called the *basal junction.* The bottom of the point is the *base.*

Attributes

Each of the seven point categories shown in Figure IV-2 has been subdivided into attributes, as shown in Table IV-1. The additional categories–Dimensions and Chipping Techniques–have been added for a more complete description. (No separate category has been developed for point edges since edges are included in the attributes of the body, the shoulder, and the stem.)

Table IV-1. Categories of Projectile Point Attributes

Category	Number of Attributes
Tip	6
Body Edge	15
Shoulder Edge	10
Stem Edge	9
Notch	5
Basal Junction	7
Base	11
Dimensions	11
Chipping Techniques	36
Total	**110**

The attributes selected are those that appear to be significant to or characteristic of each type. For recording purposes, we devised a three-letter code for each attribute. This system permitted us to record and analyze 40 kinds of attributes (within which there are 290 possibilities plus another 150 attributes of metric measurements) for each point and to compare that point to other points either mechanically or by use of a computer program. Since computer time was expensive, we chose a mechanical means that permitted us to compare the attributes of all points found. An attribute cluster–a group of points with more than 90 percent of its attributes in common–may be studied to determine temporal and spatial significance and possibly to clarify existence of type. The method described permitted rapid and accurate typing of points found in Todsen Cave and the North Mesa site and is readily adaptable to points found in other excavations or in surface collections.

A detailed explanation of the nine categories used and the attributes for each category of form follows, accompanied by descriptive drawings.

Form

1. Tip. Many tip variations are possible but only six seemed temporally and spatially significant. Two basic subcategories were defined: acute tips, those with an angle of 45° or less measured from the vertical line midpoint of the tip to the tip edge; or oblique tips, those with an angle greater than 45°. Each subcategory was subdivided into convex, concave, or straight-edge attributes (see Figure IV-3).

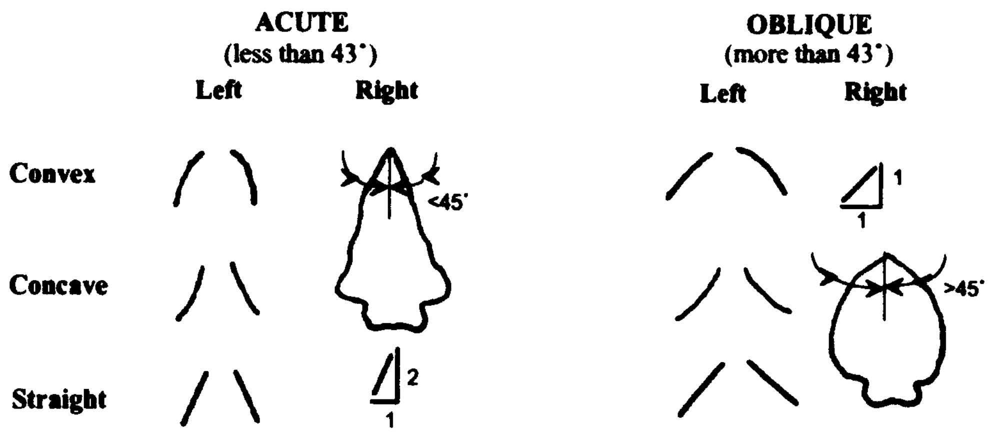


Figure IV-3. Tip Attributes

2. Body Edge. Body edges may be parallel, converging, or contracting; these subcategories may be divided further, depending on whether the sides are convex, concave, straight, S-shaped, or Z-shaped. This category has 15 attributes.

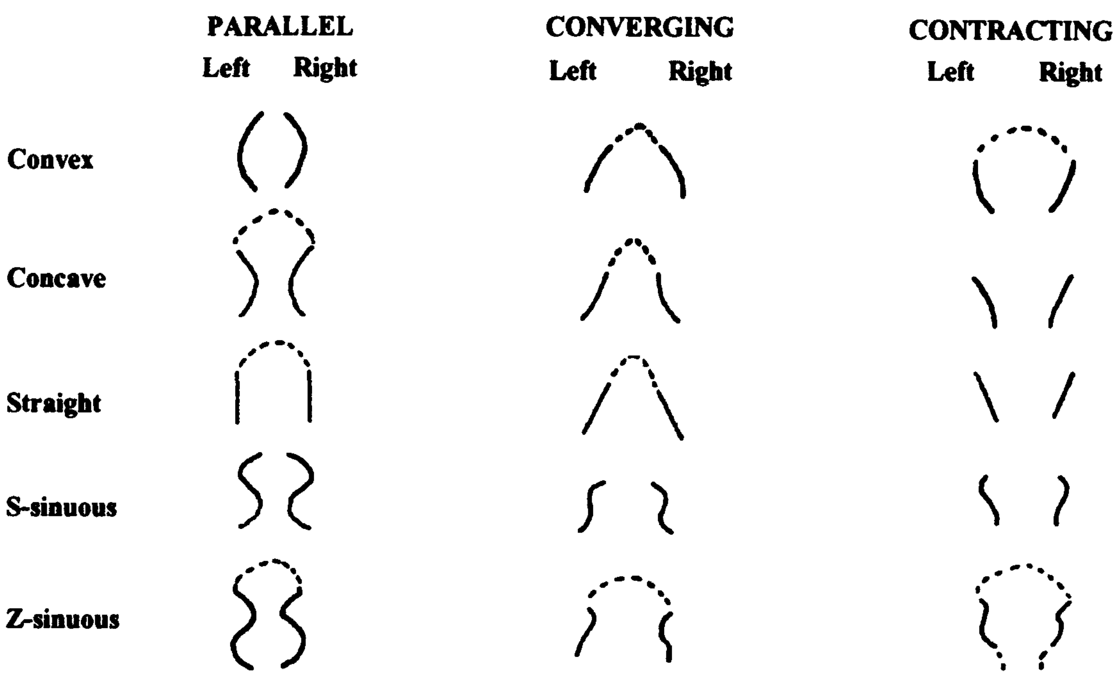


Figure IV-4. Body Edge Attributes

3. Shoulder Edge. Shoulder edges are difficult to create, and the variation in them is tremendous. Nevertheless, we were able to ascertain three basic subcategories, angled, rounded, and obtuse, as shown in Figure IV-5. These subcategories were subdivided further into six attributes: acute angled, right angled, sharply acute, basal acute (V-shaped), and obtuse angled or rounded.

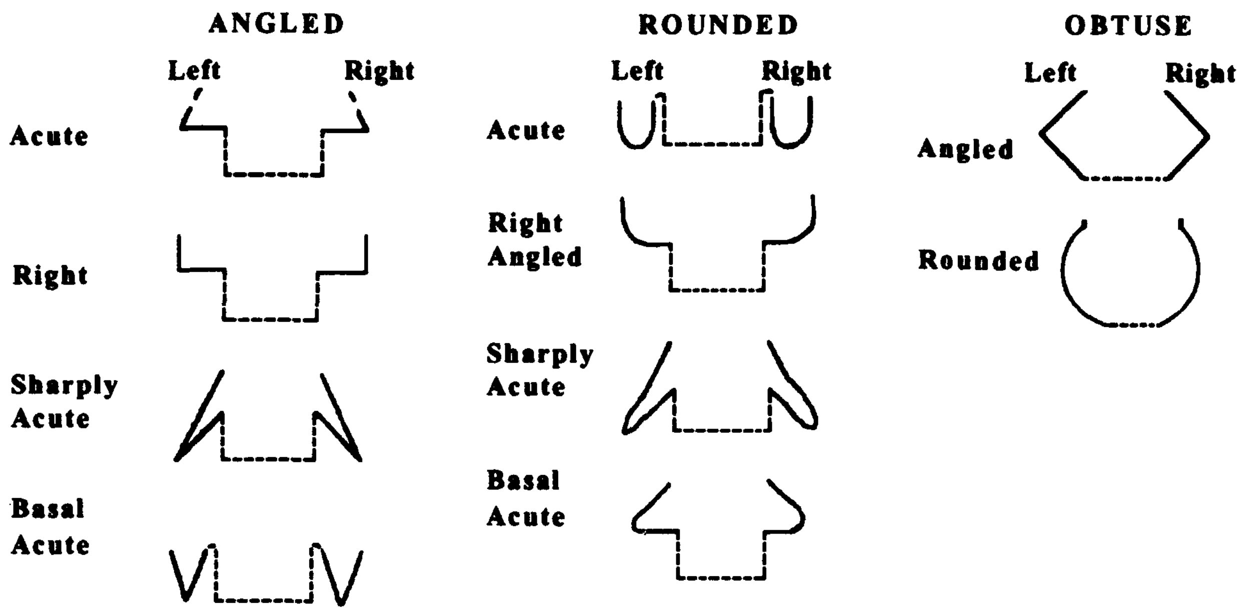


Figure IV-5. Shoulder Edge Attributes

4. Stem Edge. We noted three subcategories for stem edges–parallel, contracting, and expanding–and three attributes for each of these subcategories (see Figure IV-6).

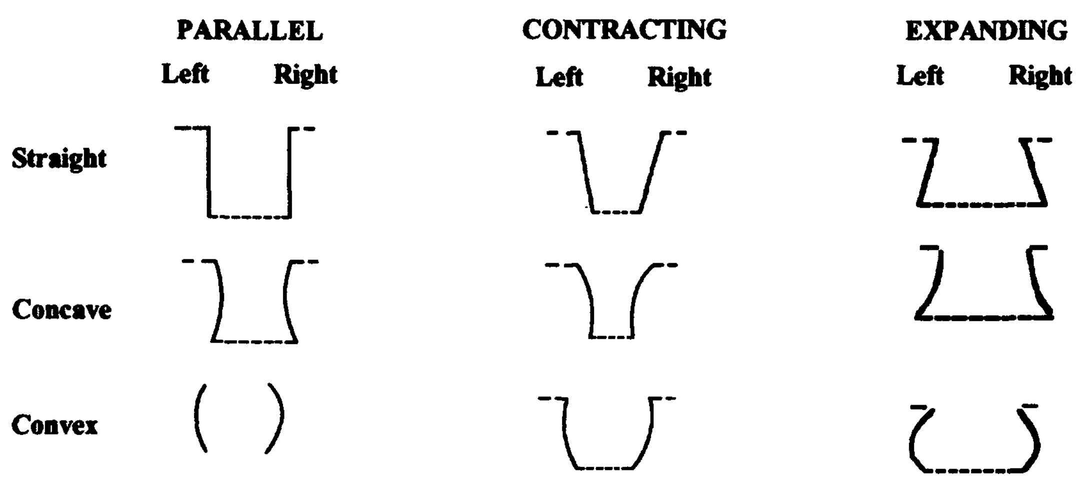


Figure IV-6. Stem Edge Attributes

5. Notch. A notch is either oblique, having an angle of more than 33°, or acute. If oblique, the notch is either concave or sharp; if acute, it may be concave, sharp, or right-angled square (see Figure IV-7).

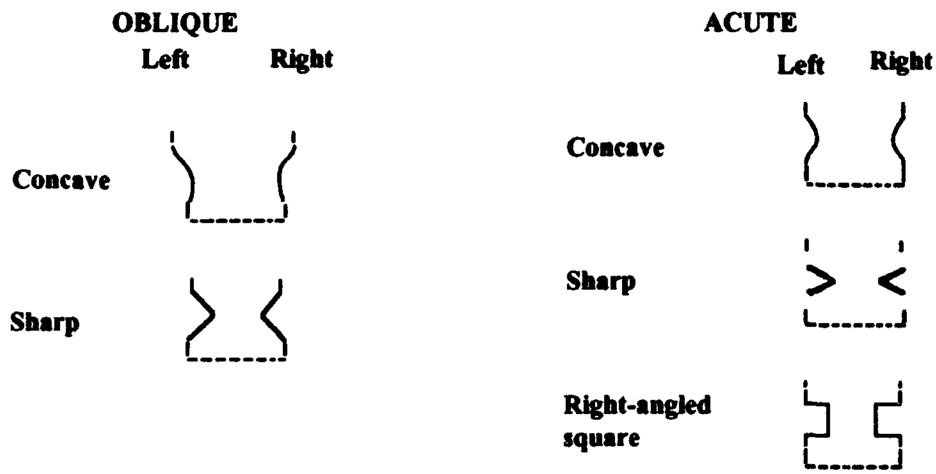


Figure IV-7. Notch Attributes

6. Basal junction. The basal junction–the point at which the stem edge and base meet in stemmed points, or the point at which the body edge and the base meet in stemless points–may be angled or rounded. Each of these subcategories may be obtuse, acute, or right-angled (see Figure IV-8).

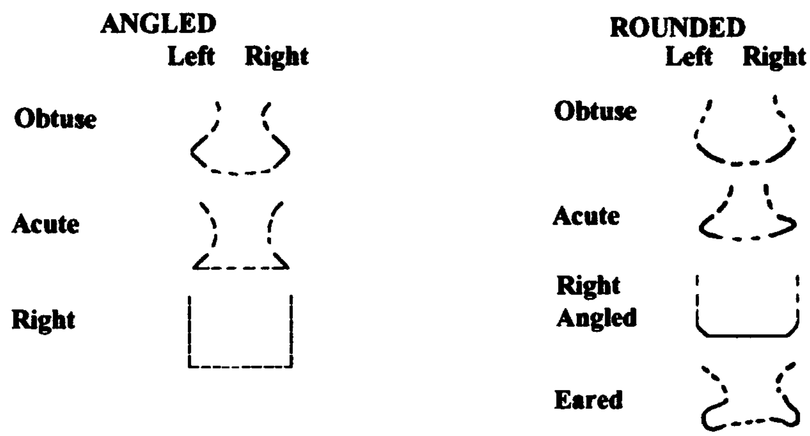


Figure IV-8. Basal Junction Attributes

7. Base. We noted much greater variation for bases. They may be divided into four subcategories–concave, convex, notched, or sinuous–and may be divided further into 11 attributes (see Figure IV-9). Also, bases may be straight or deeply or only slightly convex or concave. A notched base may have one or two notches, and a sinuous base may have an S or Z shape.

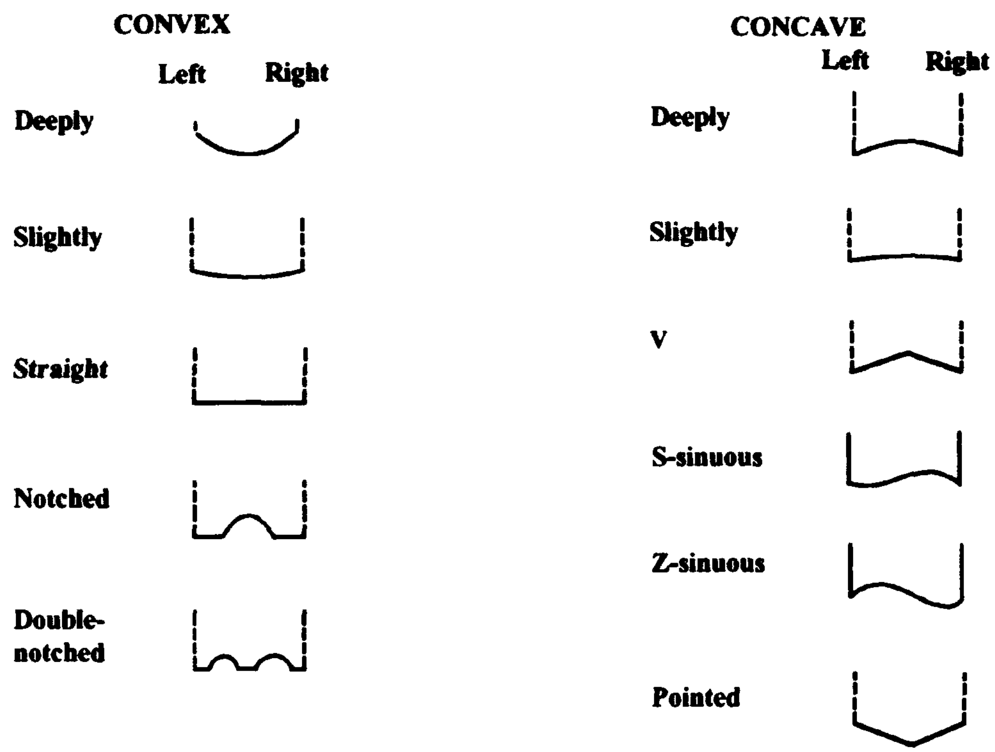


Figure IV-9. Base Attributes

8. Dimensions. The various dimensions (see Figure IV-10) of points have 11 attributes. These dimensions vary considerably from culture to culture and are an important consideration in our typology. They are as follows:

Maximum length from the tip to the base
Maximum width, usually left shoulder to right shoulder or left basal junction to right basal junction
Maximum thickness measured from the dorsal end to the ventral end
Distance from the tip to the maximum body width
Body length, the distance from the tip to the junction of the stem and body
Body width, usually from shoulder to shoulder (often the same as the maximum width)
Notch depth
Stem length, the distance from the junction of the stem and body to the base
Stem distal width, maximum distance between the left and right stem edges
Stem proximal width, the width of the stem base
Base width

In a stemmed point, the stem proximal width and the base width normally are the same. A stemless point, of course, has no stem measurements. For consistency, we have measured all dimensions in millimeters and have used a three-digit number: 00.7 mm, 01.2 mm, 09.5 mm, 1.05 mm, 1.12 mm, etc.

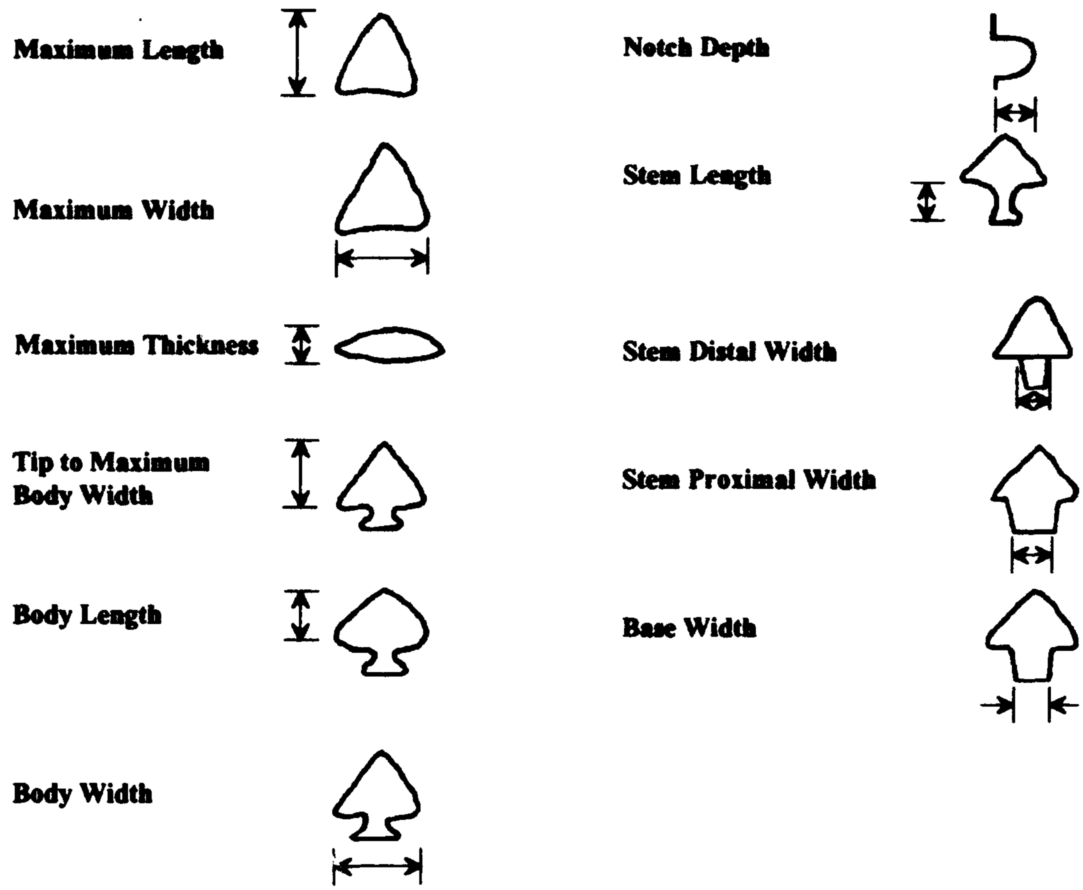


Figure IV-10. Dimensions of Projectile Points

9. Chipping Techniques. Chipping techniques vary tremendously from culture to culture and even between individual points within a culture for the obvious reason that projectile points are not machine-made. However, as with other aspects of any culture, there is a "right" way of chipping that is detectable. Within this category, we used the various divisions of a point shown in Figure IV-2. Table IV-2 outlines the subcategories and attributes for each point category. Each attribute is illustrated in Figure IV-11.

Table IV-2. Chipping Technique Attributes for Each Point Category

	ATTRIBUTES										
Subcategories	Pressure					Percussion					
	Crude	Fine	Serrated	Notched	Ground	Crude	Fine	Rippled	Collateral	Ground	Fluted
Tip	X	X	X			X	X				
Body	X	X	X			X	X	X	X		X
Body Edge	X	X	X	X	X	X	X			X	
Stem Edge	X	X	X	X	X	X	X			X	
Base	X	X		X	X	X	X			X	X

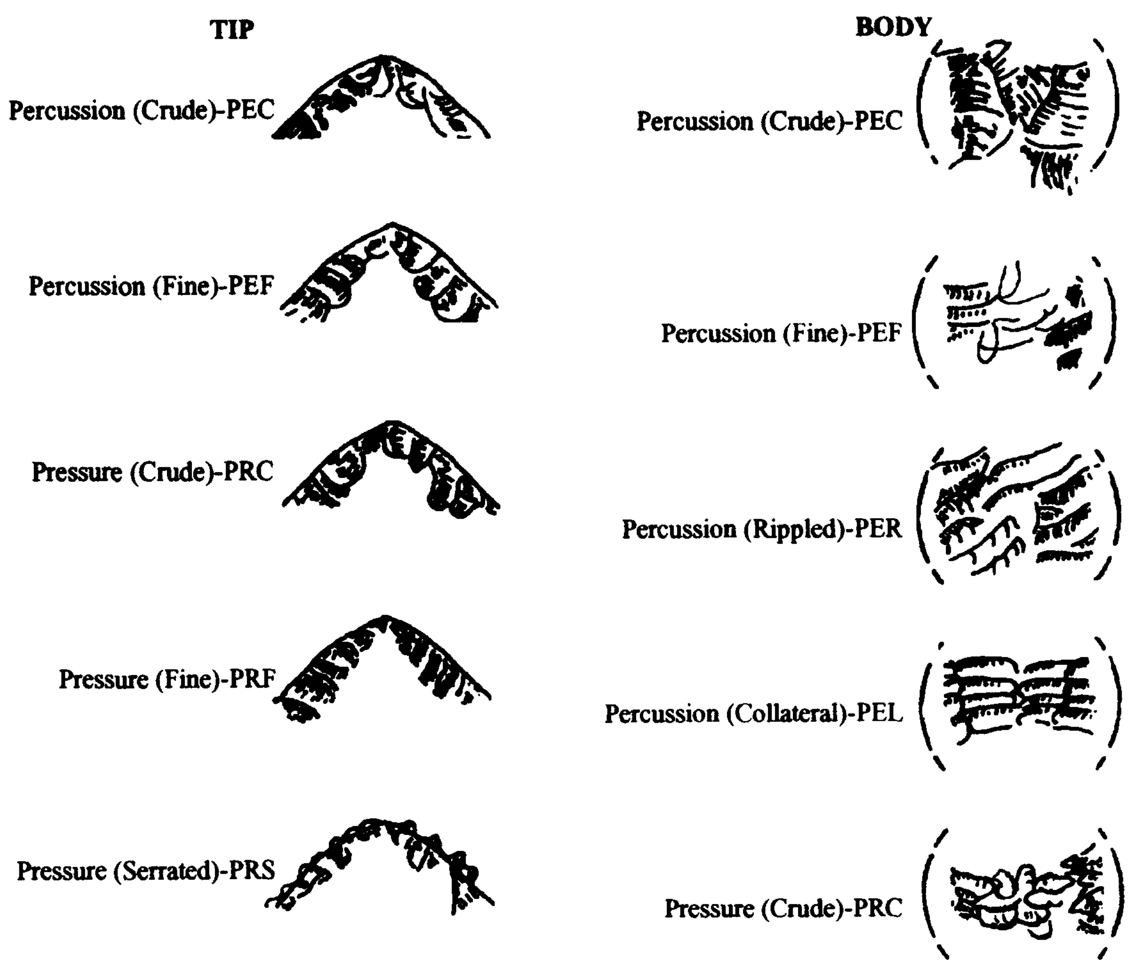


Figure IV-11. Chipping Technique Attributes

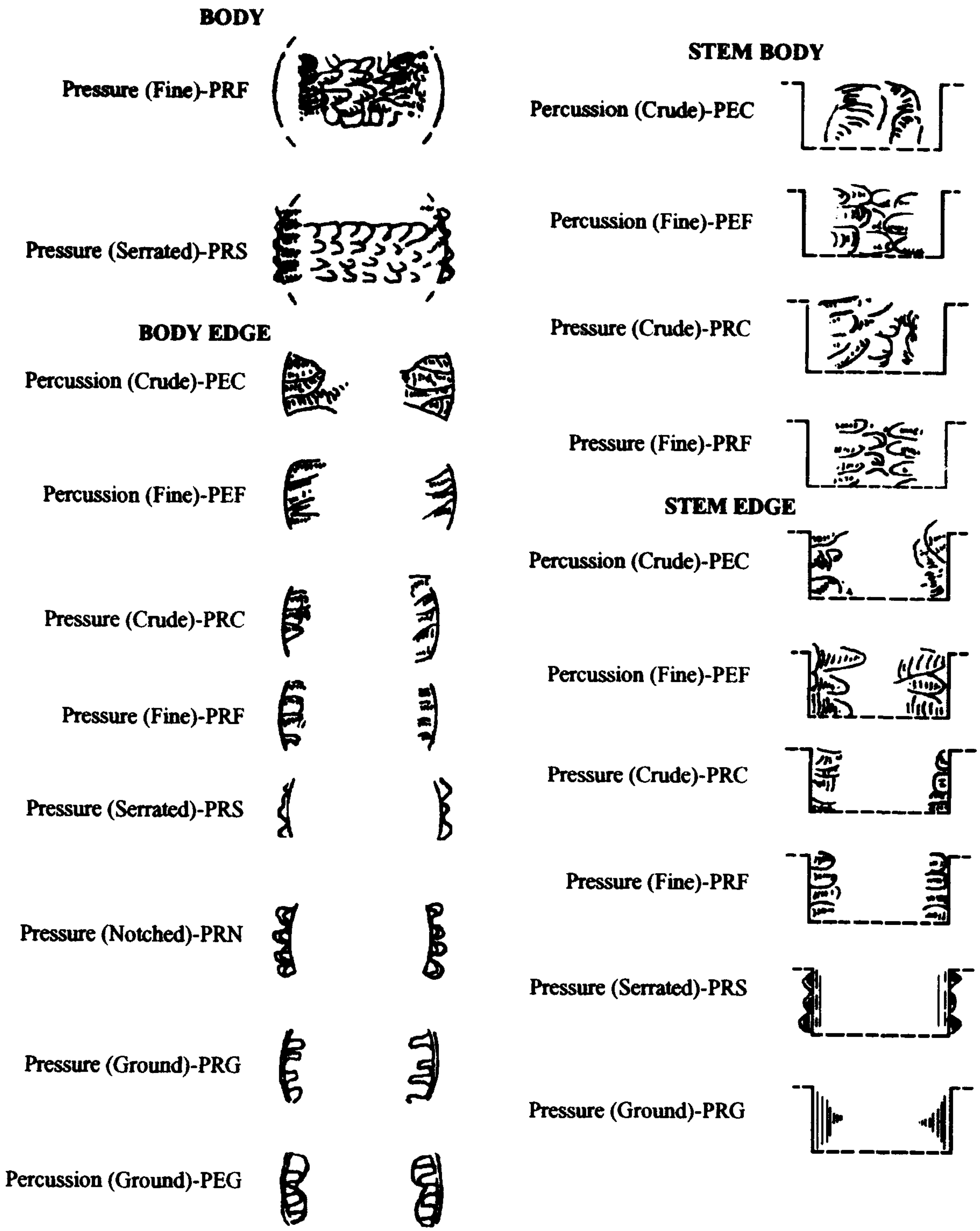


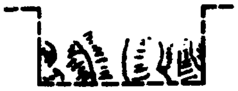
Figure IV-11. continued

BASE

Percussion (Crude)-PEC

Pressure (Fine)-PRF

Percussion (Fine)-PEF



Percussion (Fluted)-PET

Pressure (Crude)-PRC

Pressure (Ground)-PRG

Figure IV-11. continued

We next recorded all the attributes of all the projectile points on 3"x5" cards (see Figure IV-12).

CATALOGUE NO.:
TYPE:
FORM

Tip: R____ L____
Body: R____ L____
Shoulder: R____ L____
Notch: R____ L____
Base Jt.: R____ L____
Stem: ____ Base: ____

DIMENSIONS
Max. L.: ____
Max. W.: ____
Max. Thk.: ____
Tip to Max. Body W.: ____
Body L.:
Body W.:
Notch Depth-R ____
-L ____
Stem L.: ____
St. Distal W.: ____
St. Prox. W.: ____
Base W.: ____

CHIPPING TECHNIQUE
Dors./Vent.
Tip ____/____
Body ____/____
Edge-R____/L____
-L____/R____
Stem
Edge-R____/L____
-L____/R____
Stem Body ____
Base ____

Site
level
zone
square
cataloguer
tip
date
base
type
Drawing of point
(dorsal face up)

Figure IV-12. Cards for Recording Attributes

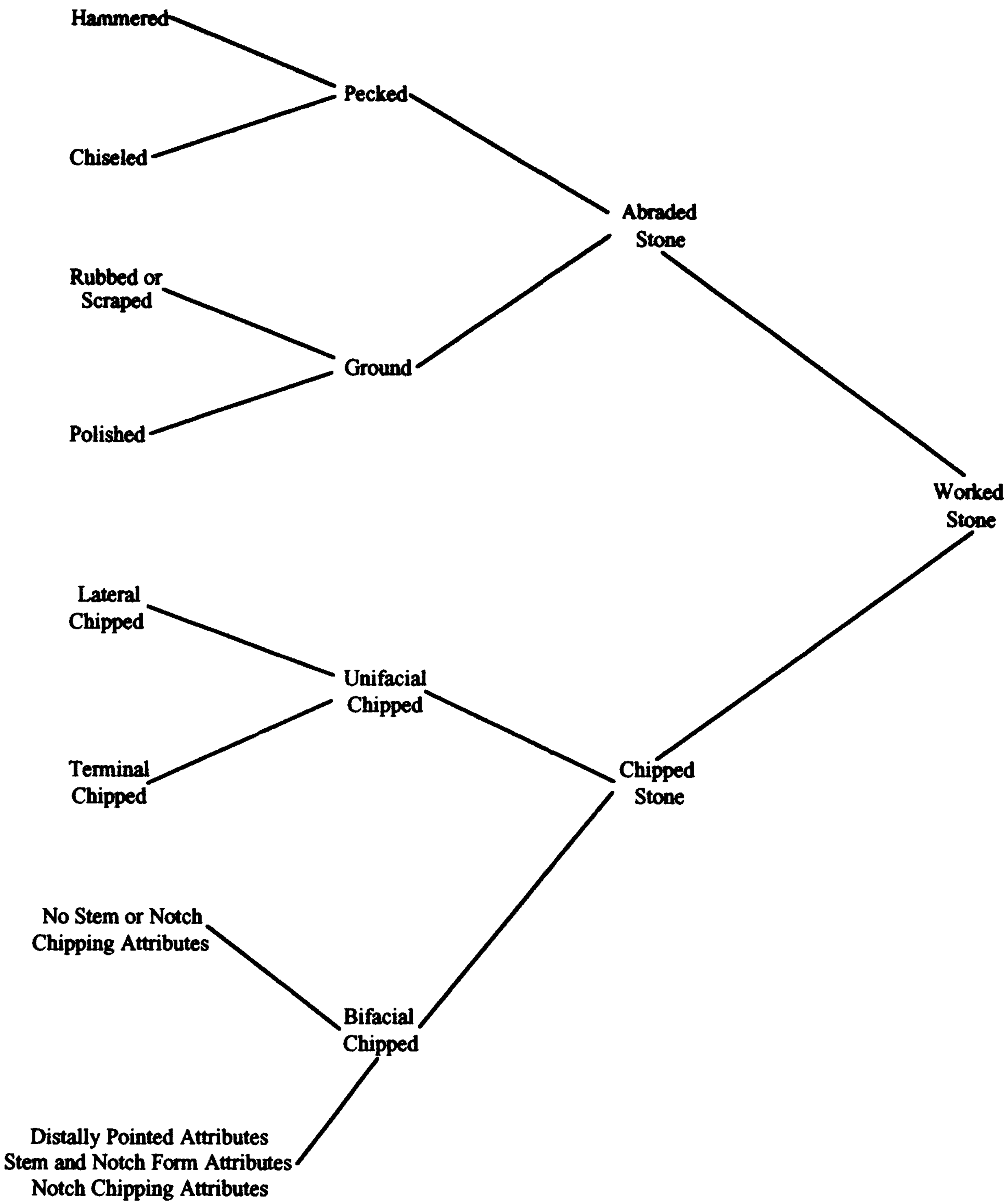


Figure IV-13. Gross Attribute Clusters for Worked Stone

Figure IV-14. Cluster Attributes Indicating Types of Projectile Points

All other worked stone objects–chipped, ground, or pecked–were recorded in a similar manner, and all were submitted for cluster analysis. Obviously, the ground and/or pecked stone could be separated immediately from the chipped stone. Within the chipped stone category, the chipping technique attributes divided the whole group into two major categories: bifaces, or worked stone that had chipping on both the ventral and the dorsal surfaces; and unifaces, worked stone chipped only on one surface. The bifaces could be divided further into two groups–those with form attributes of shoulder (right and left), notch (right and left), and stem (right and left) as well as chipping techniques of stem edge dorsal (right and left) and ventral (right and left); as well as stem dorsal and ventral, and those bifaces that did not have these attributes. We found that the former group always had some sort of pointed tip on the distal end, rather than the dozen or so other distal end forms of other kinds of bifaces such as choppers, knives, hammers, and so on. Thus, on the grossest level, we could classify worked stone into several attribute clusters (see Figure IV-13). Our real concern, however, was with the pointed biface subdivision that had facilities (stem or notch or special spaces) for hafting, or, in the common jargon, projectile points.

The projectile points broke into two major categories–those with a stem and/or notches and those without; those in turn subdivided into short delicate points (arrow points) and long thick ones (dart or lance points). The 400 or so points from excavation and the 300 from surface collection thus were divided into these four major categories immediately.

Since we were digging mainly early sites, the short delicate points, either stemmed or unstemmed, were represented by the fewest examples and had the fewest possible clusters. The short, delicate stemmed group had only two major clusters in it–those with side notches that could be further broken into Zavala, Harrell, and Toyah types, and those with stems and corner notches, or Bonham and Steiner types. The stemless group of small arrow points could be divided into those with convex bases (Padre Gordo type), and those with concave or straight bases–Garza, Fresno, and Cameron types. These divisions gave us ten groups or trial types of arrow points that had clusters of attributes (usually more than 85 percent of attributes in common for each cluster).

The larger points were much more numerous and presented more problems. The group easiest to classify as to attribute cluster was the stemless points, which subdivided into those with a convex or pointed base–Abasalo, Lerma, and Pelona types–and those with a concave to straight base. Concave-base types included Clovis, Folsom, and Tortugas (all with flutes) and Bat Cave without; straight-base types included Nogales and Angostura points (see Figure IV-14).

The stemmed group of large, pointed bifaces could be divided into four groups on the basis of stem form–contracting, straight, expanding (due to corner notches), and convex (due to side-notching). The notched stems could be subdivided further into those with narrow, deep side notches and those with wide, shallow side notches. Each of these categories was comprised of trial types with 80 percent or more of their attributes in common. The deep side-notched trial types were La Cueva, Chiricahua, Todsen, and Armijo, as against San Pedro Large and Small and Basketmaker II wide, side-notched trial types. The corner-notched types with expanding stems were divided into two groups on the basis of base attributes. Those with convex bases included the trial types Palmillas-En Medio, Hueco, and Hatch; those with concave bases included the San Jose and Amargosa trial types. Straight stem types included Bajada, Fresnal, Hoxie, and Pedernales, and contracting stem types included Maljamar, Augustin, Jay, and Gypsum-Almagre. Given these clusters of trial types, the question became, did they have temporal significance? Were they good time markers?

Upon initial analysis our excavated stratigraphic zones in Todsen Cave showed that many of the trial types did have temporal significance, as follows:

Zone Kl: Jay, Abasolo
Zone K: Abasolo, Jay, Amargosa, Pelona, Todsen
Zone Jl: Jay, Lerma, Pelona, Todsen, Augustin, Chiricahua, Nogales, Armijo
Zone J: Abasolo, Todsen, San Jose, Augustin, La Cueva, Nogales, Fresnal, Armijo
Zones πJ, E, and F: Abasolo, Nogales, Hatch, Hueco, San Pedro Large and Small, Palmillas-En Medio

Zones D through A, the upper zones with pottery, had a few distinctive arrowpoint types–first Fresno and Padre Gordo, Toyah, and Steiner; later Garza, Bonham, Zavala, Harrell, and Cameron.

The trial types not found at Todsen Cave were present at the North Mesa site, as follows:

Lower Zones: Clovis, Angostura Next *Zones:* Bajada, Jay
Zone B: Pedernales, Bat Cave, San Jose, Todsen
Zones AB and A: Hatch, Hueco, San Pedro Large and Small, Padre Gordo

Most importantly, the presence of these points at North Mesa allowed us to correlate and integrate its zones with those at Todsen. Thus, zones D and E at North Mesa were earlier than anything at Todsen; zone C was roughly contemporaneous with zone Kl of Todsen because it had possible Jay and Abasolo points, while zone B2 was like Todsen's zone K in having Todsen and San Jose points. The upper zones of North Mesa were like zones J and F of Todsen.

In fact, the analysis and comparison of points allowed us to correlate the stratigraphy of Todsen (LA5531) and North Mesa (LA5529) with other excavated sites in the region: La Cueva, Fresnal, Keystone, and the Organ Mountain sites of Tornillo, Knee Pad, Sonrisa, Roller Skate, Rincon, Thorn, and Peña Blanca (see Table IV-3). This correlation also allowed us to define four hypothetical Archaic phases–Gardner Springs, Keystone, Fresnal, and Hueco–which we could test by analysis of other artifacts and ecofacts. These comparisons, in turn, further defined our point types and indicated their temporal and spatial significance.

Comparison with other regions or subareas further defined these types, confirmed their temporal significance, and indicated their spatial significance; more importantly, it allowed us to correlate their sequence of phases with our sequence of phases in the Jornada area (see Figure IV-15).

Comparisons with the sequence of types in the Arroyo Cuervo of the Colorado Plateau indicated Irwin's Jay and Bajada phases were roughly contemporaneous with our Gardner Springs phase because of the presence of Bajada and Jay points in both. The presence of San Jose and Amargosa points in her San Jose phase of her Oshara tradition, as well as in our late Keystone-early Fresnal phases showed they were roughly contemporaneous, while Armijo and La Cueva points of Irwin's Armijo phase occurred in our late Fresnal and early Hueco levels. En Medio, Hueco, and Padre Gordo points of our Hueco and Mesilla phases occurred in their En Medio and Trujillo phases, indicating they were roughly contemporary.

Table IV-3. Correlation of point Types at Various Sites in the Jornada Region

KEY:

FTF = Fine Tip Fragment	M = Maljamar
FBF = Fine Body Fragment	FR = Fresnal
HO = Hoxie	N = Nogales
C = Cameron	LC = La Cueva
W = Washita	CH = Chiricahua
F = Fresno	AG = Augustin
T = Toyah	SJ = San Jose
G = Garza	TD = Todsen
Z = Zavala	P = Pelona
B = Bonham	GA = Gypsum-Almagre
S = Steiner	AP = Amargosa-Pinto
TTF = Thick Tip Fragment	BC = Bat Cave
TBF = Thick Body Fragment	LL = Lerma-like
PG = Padre Gordo	BJ = Bajada
EM = En Medio	JL = Jay-like
SPS = San Pedro Small	AB = Abasolo
HT = Hatch	AN = Angostura
SPL = San Pedro Large	FL = Folsom
H = Hueco	CL = Clovis
A = Armijo	AU = Ayacucho Unifacial

Table IV-3. Correlation of Point Types at Various Sites in the Jornada Region

TYPE	TOTAL	LA5529, Zone E	LA5529, Zone D	LA5529, Zone lower C	Fresnal, Zone H	LA5531, Zone K	LA5529, Feature 1	Peña Blanca, level 8	LA5531, Zone K	Rincon, level 7	LA5529, Zone lower B	Keystone, House 2	Knee Pad, level 6	La Cueva, depth 4.6+ m	La Cueva, 3.8 to 4.5 m	La Cueva, 3.4 to 3.7 m	Keystone, Zone 4	Fresnal, Zones D-F1	LA5531, Zone J1	LA5529, Feature 2	La Cueva, 3.2 to 3.3 m	LA5529, Zone middle B	Tornillo, Zone B	LA5531, Zone J	LA5531, Zone J	Knee Pad, levels 1-5	La Cueva, 2.8 to 3.1 m	La Cueva, 2.6 to 2.7 m	La Cueva, 2.4 to 2.5 m	Keystone, Zone 2	Roller Skate, levels 5-6	PHASE
FTF	12																															EL PASO or DOÑA ANA
FBF	5																															
HO	2																															
C	6																															
W	4																															
F	2																															
T	4																															
G	4																															
Z	9																															
B	5																															MESILLA
S	4																															
TTF	22							1	1															1	4							
TBF	20								2										1			1			4							
PG	7																															
EM	9																								1				2			
SPS	40																								1		1	2	2			
HT	22																	1			1		1		3	1	1			1		
SPL	20																								3		1		1	1	1	
H	48																								3	2	1	3	2	1	2	HUECO
A	18													1	1		3		3			3		1			1		2			
M	2																	1														
FR	11																1	7						1								
N	14																		1				1	1	2		1					
LC	15													2	1			6						1			2	1				
CH	11													1		2	1	1	1		1											
AG	10															1		1	1		1	1		3				1				FRESNAL
SJ	10													1		1		1		1				2				1	1			
TD	8									1	2							1	1					2						1	1	
P	3								1				1						1													
GA	3								1				1																			
AP	8								4					2							1											KEYSTONE
BC	2								1																							
LL	10										1								1													
BJ	5				1		1																									
JL	8					1	1	1	1																						1	
AB	36					1			1						2	1		2			1	2		5	4		1	1				
AN	1																															GARDNER SPRINGS
FL	1																															
CL	5		1	1							2																					
AU	1	1																														
TOTAL	424																															
PHASE		PRE-CLOVIS CLOVIS			GARDNER SPRINGS				KEYSTONE							FRESNAL									HUECO							

Table IV-3. continued

TYPE	Fresnal, Zones B-C2	La Cueva 2.1 to 2.3 m	La Cueva, 1.8 to 2 m	LA5529, Zone upper B	LA5529, Feature 7	LA5531, Zone E	Sonrisa, level 3	Roller Skate, level 4	Rincon, level 5	Sonrisa, level 2	LA5531, Zone D2	LA5529, Zone AB	Peña Blanca, level 5	Sonrisa, level 1	Roller Skate, levels 2-3	LA5531, Zone F+	Thorn, level 2	LA5531, Zone D1	Peña Blanca, level 4	Peña Blanca, level 3	Rincon, levels 3-4	Roller Skate, level 1	Rincon, levels 1-2	Peña Blanca, levels 1-2	LA5531, Zone D	LA5531, Zone C	LA5531, Zone B	LA5531, Zone A	LA5529, Zone A	LA5531, surface	LA5529, surface	PHASE
FTF											2		1			2		1	1		1		1	2				1				EL PASO or DOÑA ANA
FBF										1						2		1				1										
HO																				1				1								
C											1								1				1	1		1		1				
W																							1	2		1						
F																				1			1									
T																2							1							1		
G																							1	2			1					
Z											1					2			1	1	1			1	2							
B											1					2				1										1		MESILLA
S											2					1								1								
TTF				1		1						2	1			1		1	1				1									
TBF				2						2						1															2	
PG			1	1								1		1		1								1			1					
EM	2		1	1												1															1	
SPS	26	1	3	1																			1								2	
HT	1		3			1	1	1			1	1	1		1								1	1					1		2	
SPL	2	1	3	1												1	1			1				3								
H	4		6	1	1			1	1	1		1			2	1			4	1	4	2		3					1	1		HUECO
A		1	1																					1								
M			1																													
FR			2																													
N	1	3	1																			2		1								
LC			1																			1										
CH			2	1																											1	
AG												1																				FRESNAL
SJ			2																													
TD																																
P																																
GA																														1		
AP																															1	KEYSTONE
BC																															1	
LL																													1		7	
BJ				1								1																			1	
JL													1								1							1			1	
AB			5						1										2	1	1	1	1	1								
AN																															1	GARDNER SPRINGS
FL																															1	
CL																															1	
AU																																
PHASE	HUECO									MESILLA								DOÑA ANA				EL PASO										

Other close connections on the basis of projectile point similarities could be made between our Jornada sequence and the Cochise tradition to the west. These correlations mainly were of the Late Archaic time period, although some of the few projectile points found at Sulphur Springs (8400-5500 B.C.) could be bases or stems of Jay points, indicating a connection to our Gardner Springs phase as well as Irwin's Jay phase and the Mohave Lake culture of California. Better indications of relationship seem to appear during the Fresnal-Chiricahua time period. Both Jornada and Cochise sites have San Jose, Felona, Augustin, Amargosa, and Chiricahua points in common and must be roughly contemporaneous on the 3000-1000 B.C. time level as well as coeval with San Jose to the north. The Hueco and San Pedro phases have in common San Pedro, Hueco, and Basketmaker II points, indicating they also are contemporaneous. No manifestation of Cochise, however, seems to contain the Keystone complex of projectile points, nor has any culture phase of the 6000-3000 B.C. time period been found in the Cochise region. On the other hand, Ventana Cave to the west and California Amargosa I, with its Gypsum Cave and Amargosa points, could be of this time period.

Connections between our Jornada sequence and cultures to the east also are hard to establish, not because of culture absences, but just because of plain lack of relationships. On the Paleo-Indian level, from 10,000 to 7000 B.C., there are good relationships (Clovis, Folsom, and Angostura points) and perhaps even the same culture manifestations, but after that things go downhill. On the Gardner Springs time level of the Early Archaic, only the Travis and First-view sites of Texas bear resemblance to Bajada, but the similarities are slight. In the Keystone time period of the Early-Middle Archaic, the only real resemblance is in the Pedernales and Almagre-Gypsum points of central Texas and Baker points of the Big Bend region, but again the similarities are few and the more dominant Texas types simply do not appear in the Southwest. In Fresnal times of the Middle Archaic, there are resemblances between Frio and Chiricahua types, and Tortugas and Shumla points occur as minorities on surface sites of the Fresnal phase. Perhaps the best connection is the Maljamar point found in west Texas and the Jornada region. Hueco-level connections of the Late Archaic are not good, although some Texas Ensor types resemble San Pedro and Basketmaker types, and Marcos and Marshall types have similarities to Hatch and Hueco points, but these resemblances are vague and unsatisfactory.

It is somewhat surprising, following these not-very-precise relationships of points on the Archaic levels, that the later arrow points are strikingly similar, particularly since the Texas pottery (or lack thereof) and agriculture subsistence systems are totally unlike the situation in the Southwest. Undoubtedly this resemblance results from the rapid spread of the bow and arrow through both areas when other contacts were nebulous and not established firmly. On the earlier level (A.D. 500-1000), Toyah and Fresno points appear in both areas, while Steiner also may reach the Jornada area as a minority type. On the later level (A.D. 1000-1300), Garza, Bonham, and Zavala points occur, while Cameron and Harrell start in this time period and probably last into Apache times in the seventeenth to nineteenth centuries.

In addition to revealing good time and space relationships, these projectile points also indicate functional use and contextual changes through time. The major use of arrow points and the bow and arrow is very recent, although this type of weapon may have been known much earlier. Further, thanks to good preservation in caves such as Chavez (near Todsen), we know the arrows often were made in a form similar to the earlier dart (atlatl) points: A stone tip inserted in a wood foreshaft was placed in a mainshaft with a base, reinforced with a V-shaped notch, or had inserted into its reinforced base a feathered end shaft that was reinforced with a V-shaped notch. Before A.D. 500, the atlatl and the atlatl dart were the major weapons, dating clear back perhaps to Clovis times, with lances or javelins seemingly always a minority type or absent. Why these atlatl dart features continued is unknown, for in other areas they usually are absent after the arrow arrived.

Further, all points are attached to foreshafts and not directly to mainshafts. Why? The variety of stems and notches in our Archaic points seemingly indicates different types of hafting or techniques of attachment, but the many examples preserved with wood, string, and gum show all points are attached by wrapping the string, yarn, or thong round and round, not crisscross or in one of the many other manners possible. Why do so many changes in types of bases seem to occur during definite time periods in different areas?

Thus, while we may understand the chronological relationships of our projectile points, we understand little about them functionally and contextually. In fact, this whole "culture" aspect is in its infancy and is a fertile field for future studies. However, we do have some knowledge of other types of projectile points that will aid in chronological and relationship studies; these descriptions are presented on the following pages.

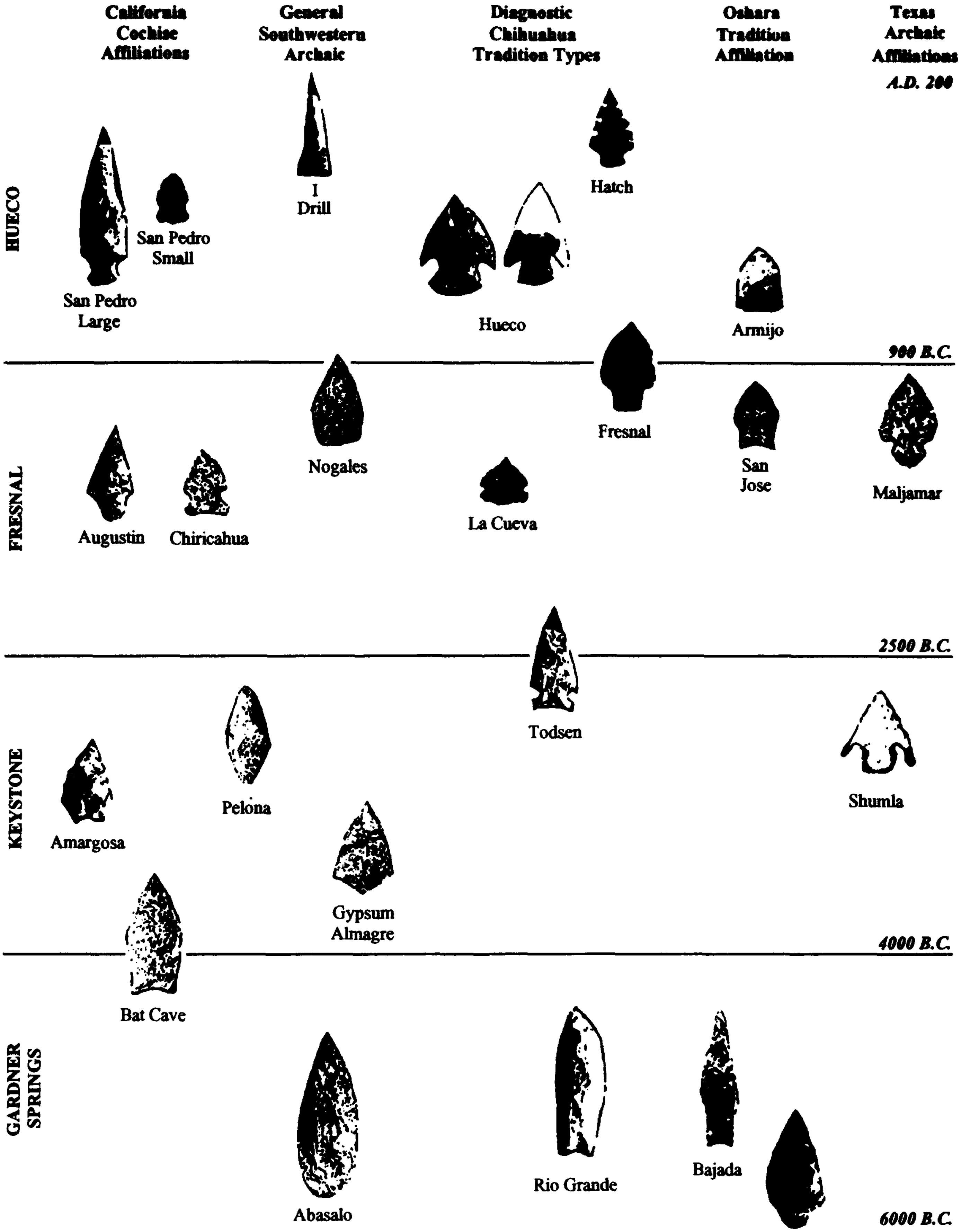
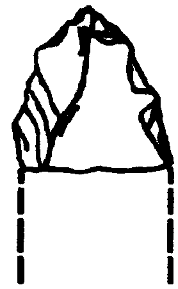


Figure IV-15. Comparison of Points in the Jornada Region with those in Adjacent Regions

TYPE: AYACUCHO UNIFACIAL

Source of
Drawing: Zone E of North Mesa



Sample

Excavation	11
Surface	1
Pictorial	2
Total	**14**

Description (based on a sample of 2)

Dimensions (in mm)

	Mean	**Range**
Maximum length	42.0	?
Maximum width	27.0	17.0-37.0
Maximum thickness	9.8	9.40-10.2
Tip to maximum body width	42.0	
Body length	42.0	
Body width	27.0	17.0-37.0
Basic width	27.0	17.0-37.0

Form and Chipping Technique

Tip: These have been pressure retouched unifacially on the converging convex tips.

Body: Convex converging and parallel edges–not retouched–just a flake with dorsal scars parallel to edges.

Base: One is more or less straight at right angles to the body edges.

Relationships

Although calling these Jornada flake points by a Peruvian name (MacNeish 1980) will bring loud objections from my colleagues, I do this for the sake of uniformity. Further, similar points, and probably also related, are unifacial points from Meadowcroft rockshelter (Adovasio et al. 1975)–now called Mungo points–and Cynthia Irwin-Williams' Valsequillo points from her site in Puebla (Irwin 1967). Further, I believe the pointed flakes from Tibito (Correal 1986) in Colombia, similar ones from the Diablo complex in Mexico (MacNeish 1958), some from the lower levels of Sao Raimundo in Brazil (Guidon 1986), and the lowest level of Las Toldas in Argentina (Cardich et al. 1973) are the same type. All are similar in form and manufacture, appear during pre-Clovis times, and everywhere precede the well-made Paleo-Indian bifacial points. I believe it is about time we recognize this important type as an entity.

TYPE: CLOVIS

Source of
Drawing: J. Smith Collection, Las Cruces, NM (see next page)

Sample

Excavation	4
Surface	7
Pictorial	20
Total	**31**

CLOVIS

Description (based on a sample of 4)

Dimensions (in mm)

	Mean	Range
Maximum length	48.9	46.2-112.0
Maximum width	26.5	23.0-38.0
Maximum thickness	4.8	3.20-6.40
Tip to maximum body width	8.9	16.0-32.0
Body length	9.0	26.0-58.0
Body width	26.5	23.0-38.0
Base width	18.4	14.0-38.0

Form and Chipping Technique

Tip: Broken–but probably pressure retouched on the converging convex tip.

Body: Parallel converging (100%). Body is fluted on both surfaces. Dorsal edges have crude pressure chipping. Ventral edges show crude percussion.

Basal junction: Acute angled.

Base: Deeply convex (100%). Ground on basal lateral edges (100%). Occasionally ground on finely retouched concave base (23%).

Relationships

Temporal: The Clovis point has been dated between about 8500 and 9600 B.C. (Haury 1950; Turner and Hester 1985). Many points in the western United States are in the later range while some from Debert, Nova Scotia, and Alaska are in the younger range. It might be added, however, that one Clovis point in poor association with a caribou bone in Duchess County, New York, gave a date of about 10,700 B.C.

Spatial: Clovis points or related types have been found all over the United States (Haury 1950, 1959), but in Mexico they extend down the coast as far as Los Grifos Cave in Chiapas (Barcena 1981), and related points occur in Central America along with fluted Fishtail points that are in South America as far south as Patagonia. These points are rare on the United States West Coast and only a couple have been reported for California. They are also rare in Canada with only a few known from Alberta, Saskatchewan, and the Debert site in Nova Scotia. A few have been reported from Alaska including those (2) from excavation at Putu (Alexander 1987).

The origin and spread of this point type have been the basis for considerable speculation, and I shall present the more extreme views. The conservatives would have the type representing one of the first migrations into America–with the type perhaps originating in Alaska 15,000 to 12,000 years ago and arriving in Edmonton, Alberta, south of the ice sheets some 12,000 years ago. The migrants then supposedly fanned out and rapidly spread southward, killing all Pleistocene fauna before them, arriving in Patagonia 10,000 to 11,000 years ago.

This "overkill hypothesis" (Martin et al. 1952) contrasts with the other view, which sees Clovis gradually developing in the United States–perhaps even in the eastern or midwestern part–from earlier complexes, perhaps with leaf points. It then slowly spread over the United States, Canada, Alaska, and northern Mexico in one general environmental area, as did the related Fishtail point complex that developed in Central America and then slowly spread south through the grassland east of the Andes to Patagonia. In this view, the Clovis point is seen as part of a late specialized hunting complex–perhaps a new use of an atlatl and its darts–that followed a series of less well adapted complexes (perhaps without atlatl, etc.) or migrations that started tens of thousands of years earlier (Hemmings and Haynes 1969).

These two views are debated loudly and at present there is not enough evidence to favor one or the other, although this author likes the evidence for the latter. Both schools, however, seem to agree that Folsom evolved out of Clovis, although no evidence of transition has been found. Thus there is much we don't know about this popular type or its relationships.

TYPE: FOLSOM

Sources of
Drawings: Left, Todsen Cave surface; right, J. Smith Collection, Las Cruces, NM

Sample

Excavation	9
Surface	1
Pictorial	20
Total	**30**

Description (based on sample of 10)
Dimensions (in mm)

	Mean	Range
Maximum length	46.25	22.0-80.0±
Maximum width	22.00	13.0-26.00
Maximum thickness	4.40	3.50-6.00
Tip to maximum body width	17.00	13.0-21.00
Body length	46.00±	22.0-80.00
Body width	22.00	15.0-23.00
Base width	18.00	16.0-22.00

Form and Chipping Technique

Tip: Mainly oblique convex (98%) with one rare acute convex. Chipped pressure crude with one rare pressure fine.

Body: Bodies are parallel convex with edges chipped by crude pressure (75%); a few are fine pressure chipped. Body surfaces always are fluted dorsally and ventrally.

Stem: None, although lower bodies of some flare out very slightly (30%); one was eared.

Basal junction: Most are angled downward and sharp and acute (75%); a few are acute but rounded (25%).

Base: Most are double-round notched (70%), but a few (30%) are deeply concave.

Relationships

Temporal and *Spatial:* The Folsom type occurs in the high plains from southern Texas to Alberta, Canada (Turner and Hester 1985). Many of the sites excavated are kill sites of giant extinct bison (Roberts 1935), but a few have been uncovered at campsites. Dates range from about 9000 B.C. to almost 7500 B.C. The complex is a specialized adaptation to a distinct environmental niche. Folsom points adapted to hunting (now extinct) buffalo in the Great Plains probably developed out of Clovis; both kinds of points may have been hafted in atlatl dart foreshafts. We do not have enough data to say into what Folsom evolved. Perhaps some of the fluted points, such as Tortugas in the Archaic period, ultimately were derived from concepts involved in this type, or perhaps some of the Plano point types developed from it.

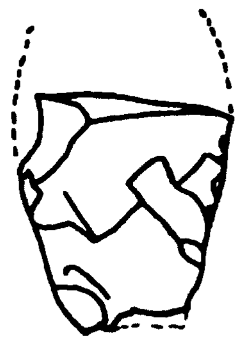
TYPE: ANGOSTURA

Sources of
Drawings: Left, North Mesa, surface; right, based on Turner and Hester 1985:66 (see next page)

Sample

Excavation	0
Surface	1
Pictorial	10
Total	**11**

ANGOSTURA



Description (based on a sample of 1)

Dimensions (in mm)

	Mean
Maximum length	34.0+
Maximum width	25.00
Maximum thickness	7.00
Tip to maximum body width	34.0+
Body length	34.0+
Body width	25.00

Form and Chipping Technique

Tip: Broken, but probably acute as well as long and very slightly converging.

Body: Converging convex (100%). Dorsal and ventral surfaces show a collateral percussion chipping (100%). Right and left ventral edges show fine and crude pressure (100%).

Stem: This point really has no stem, but the portion just above the base often is ground on the edges, giving the point a stemlike appearance.

Basal junction: Usually angled and slightly obtuse, but often ground.

Base: Narrow, straight to slightly concave.

Relationships

Temporal: The Angostura type seems to be later than Folsom, roughly from 8000 to 7000 B.C., but it is not well radiocarbon dated, and dates may vary from one region to the next (Turner and Hester 1985).

Spatial: Angostura is a basic North American plains-prairie type found in the central United States and Canada, from Texas to Alberta and perhaps even the Northwest Territory. It also extends east of the Mississippi into Wisconsin, Illinois, and Indiana, which at that time perhaps were prairie with roving herds of buffalo, either modern or extinct. A specialized type, it may have tipped either jabbing lances or atlatl darts.

From what Angostura is derived and into what it developed are unknown, but it seems to be related to a series of rippled or collaterally flaked Plano types–Plainview, Eden, Yuma, etc.–found in the Plains, which Thoms (1977) referred to as Agate Basin-serrated blades.

TYPE: JAY-LIKE

Sources of
Drawings: Left, Todsen Cave, zone Kl;
right, North Mesa, Feature 1 (see next page)

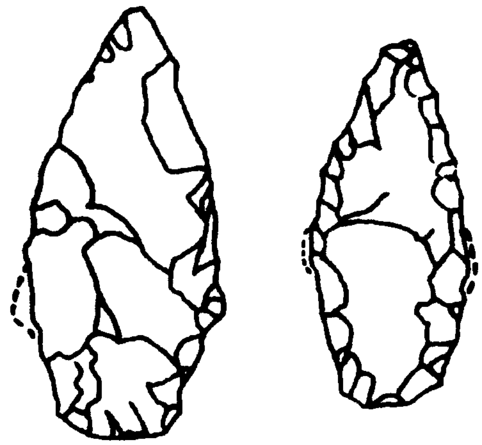
Sample

Excavation	7
Surface	7
Pictorial	4
Total	**18**

Description (based on a sample of 12)

Dimensions (in mm)

	Mean	Range
Maximum length	47.00	31.8-65.0
Maximum width	23.52	15.6-42.0
Maximum thickness	7.55	50.0-14.0
Tip to maximum body width	29.20	15.6-42.0
Body length	29.70	20.6-38.4
Body width	21.70	15.6-30.0
Notch depth R.	1.05	0.50-1.00
Notch depth L.	0.72	00.4-1.50
Stem length	24.80	14.5-34.4
Stem distal width	19.92	13.6-38.0
Stem proximal width	13.00	9.60-17.0
Base width	12.45	9.60-22.0



JAY-LIKE

Form and Chipping Technique

Tip: Acute convex (65%), and acute straight (35%). Crude pressure (45%), fine pressure (40%), serrated (10%), and crude percussion (5%).

Body: Converging convex (95%), and converging straight (5%). Dorsal and ventral surfaces show crude percussion (100%). Edges show crude pressure (40%), fine pressure (25%), serrated (25%), and crude percussion (10%).

Shoulder: Obtuse rounded (75%), right angle rounded (10%), acute rounded (10%), and obtuse angled (5%).

Notch: Oblique convex (100%).

Stem: Contracting convex (80%), contracting concave (10%), and contracting straight (10%). Stem body shows crude percussion (100%). Stem edges show grinding (40%), crude pressure (30%), fine pressure (15%), and crude percussion (15%).

Basal junction: Obtuse rounded (70%), and right angle rounded (30%).

Base: Deeply convex (40%), slightly convex (30%), slightly concave (20%), and straight (10%). Bases are crude pressure (40%), ground (20%), fluted (15%), fine pressure (10%), and crude percussion (5%).

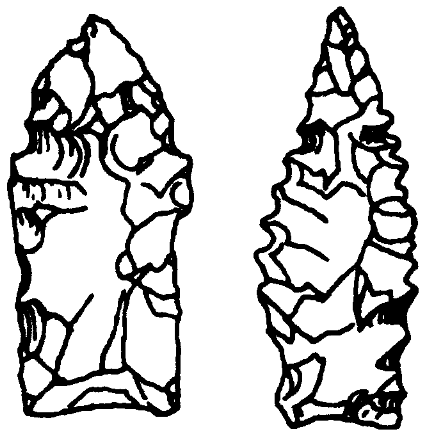
Relationships

Temporal: In both Todsen Cave and North Mesa this Jay-like type was confined to the Gardner Springs phase, dated roughly 6000 to 4000 B.C. Related types in other regions seem to be of roughly the same Early Archaic period.

Spatial: Jay-like points also occur at about a dozen seemingly Early Archaic sites in the Tularosa Basin on Fort Bliss, and we have seen some from the Socorro region along the Rio Grande to the north. Perhaps the most similar points, although not identical, are those from the Jay complex that are dated between 5500 and 4800 B.C. in the Arroyo Cuervo region of north-central New Mexico (Irwin-Williams 1973, 1979). This complex reputedly extends northeastward into the Anasazi region of the Colorado Plateau (Renaud 1942). Farther to the east Jay-like points are reminiscent of the Lake Mohave points of California (Campbell and Campbell 1935; Rogers 1939) and Arizona (Waters 1986), as well as the Silver Lake points of California (Warren 1967). One of Haury's points from the red layer, Amargosa I Ventana complex, of Southwest Arizona also is similar and could be of this time period (Haury 1950).

Generally speaking, the type is not represented by many specimens in good dated contexts, so it is poorly defined.

TYPE: BAJADA-LIKE



Source of Drawings: Todsen collection, from Tularosa Basin

Sample

Excavation	5
Surface	11
Pictorial	5
Total	**21**

Description (based on a sample of 14)

Dimensions (in mm)

	Mean	**Range**
Maximum length	49.6	42.0-59.0
Maximum width	18.6	16.0-22.0
Maximum thickness	7.0	5.00-10.0
Tip to maximum body width	26.0	22.0-35.0
Body length	27.0	24.0-35.0
Body width	18.0	15.0-21.0
Notch depth R.	1.0	0.50-1.00
Notch depth L.	1.0	0.05-1.00
Stem length	14.6	9.00-22.0
Stem distal width	14.8	11.0-20.0
Stem proximal width	14.0	11.0-19.0
Base width	13.8	11.0-19.0

Form and Chipping Technique

Tip: Usually acute convex (right and left 80%) but occasionally acute straight (20%), with mainly crude percussion chipping both dorsal and ventral, although occasionally some have fine percussion (8%).

Body: Mostly converging convex (50%), parallel convex (30%), and converging straight (20%). Both ventral and dorsal, chipping technique on body is crude percussion (100%), while edges show crude percussion (40%), crude pressure (40%) with remainder serrated by pressure flaking and percussion chipped.

Shoulder: Usually obtuse rounded ventral and dorsal (10%), occasionally obtuse angled (10%) and some right angled (10%). Mainly percussion (70%), rarely pressure flaked (30%).

Notch: Right and left concave oblique (100%).

Stem: Contracting straight (50%), parallel straight (30%), some expanding straight or concave with mainly crude percussion chipping both dorsal and ventral but some crude pressure flaking on body. Stem edges reflect crude pressure (60%), grinding (30%), with some crude percussion chipping.

Basal junction: Rounded acute angled (35%), right angle rounded (30%), with remainder right angled.

Base: Usually ground (40%), frequent crude pressure chipping (30%), with some crude percussion. Slightly convex (40%), deeply convex (30%), slightly concave (20%), with remainder straight.

Relationships

Temporal: In the Jornada subarea, Bajada-like points only occurred in Gardner Springs levels (6000-4000 B.C.) at the North Mesa site. One related point–a Rio Grande–occurred at Rincon Cave in arbitrary level 4 (probably disturbed) in the Peña Blanca-Organ Mountain region. In Carmichael's Tularosa Basin survey eight Bajada-like points came from Gardner Springs surface sites.

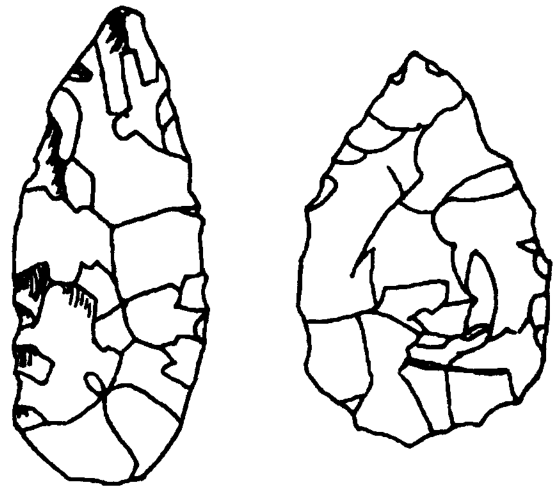
This type also occurs in the Colorado Plateau in the Bajada phase of the Oshara tradition at about the same time period and is related to the Mohave Lake type in California (Campbell and Campbell 1935).

Irwin-Williams (1979) has suggested it is earlier in that region and spread out of Nevada-California through northern Utah (Hunt and Tanner 1960), Arizona and New Mexico and then down the Rio Grande to Chihuahua, Mexico. The type seems to have bypassed southern Arizona and Sonora.

Spatial: In terms of subarea the type is

(1) absent in California-Nevada-Utah (Mohr and Sample 1959), but related poorly to Mohave types;
(2) predominant in the Colorado Plateau, and Rio Grande-Escobas types are related (Wendorf and Thomas 1951);
(3) absent in the Mogollon Rim and Gila region–there are no related types;
(4) absent in the Big Bend and only vaguely similar to Pandale and/or Travis points; and
(5) absent in northwest Texas, but Firstview points might be related.

TYPE: ABASOLO-LIKE



Sources of Drawings: Todsen Cave: left, zone J; right, zone πJ

Sample

Excavation	35
Surface	2
Pictorial	16
Total	**53**

Description (based on an adequate sample of 26)

Dimensions (in mm)

	Mean	**Range**
Maximum length	58.30	35.0-65.6
Maximum width	30.11	16.8-35.0
Maximum thickness	15.49	6.60-43.2
Tip to maximum body width	40.44	9.00-48.0
Body length	57.14	33.2-65.6
Body width	30.11	16.8-35.0
Base width	17.77	9.00-31.0

Form and Chipping Technique

Tip: Acute convex (75%), and oblique convex (25%). Crude percussion (30%), crude pressure (25%), fine percussion (15%), and fine pressure (10%). Often have crude percussion on one edge on one side and fine percussion or pressure on that edge on the opposite side, giving them a bevelled appearance.

Body: Usually converging convex (90%), occasionally converging straight (5%), with converging concave and parallel concave making up the other 5%. Body edges show crude percussion (55%), crude pressure (45%), with little fine percussion and fine pressure (5%).

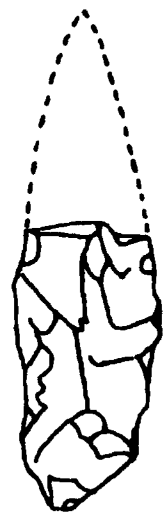
Basal junction: Obtuse rounded (80%), right angle rounded (10%), with obtuse angled and right angled making up 10%.

Base: Deeply convex (50%), slightly convex (45%), with straight, Z-sinuous, and pointed making up 5%. Crude percussion (85%), crude pressure (10%), with thinned and fine pressure totaling 5%.

Relationships

Temporal and *Spatial:* Abasolo-like points are a generalized type that lasts a long time over much of North and South America (Turner and Hester 1985). In many places they are difficult to distinguish from quarry blanks, but in other areas (particularly Tamaulipas) these types were found hafted to atlatl foreshafts and had bevelled tips (MacNeish 1958). Thus they are poor time and space markers, but as such, are significantly different from our other types.

TYPE: LERMA



Source of
Drawing: Todsen Cave, zone J1

Sample

Excavation	3
Surface	7
Pictorial	21
Total	**31**

Description (based on a sample of 8)

Dimensions (in mm)

	Mean	**Range**
Maximum length	60.5	55.0-78.2
Maximum width	22.8	17.4-33.5
Maximum thickness	11.2	10.0-12.1
Tip to maximum body width	24.0	1.90-2.80
Body length	60.5	55.0-78.2
Body width	22.8	17.4-33.5
Base width	15.5	13.0-17.0

Form and Chipping Technique

Tip: Broken, but probably acute and long and slightly convex.

Body: Parallel straight to slightly convex, crude percussion on both dorsal and ventral surface, crude percussion on all edges.

Basal junction: Obtuse rounded on right and left.

Base: Pointed base with crude percussion, but some are deeply convex with crude pressure flaking.

Relationships

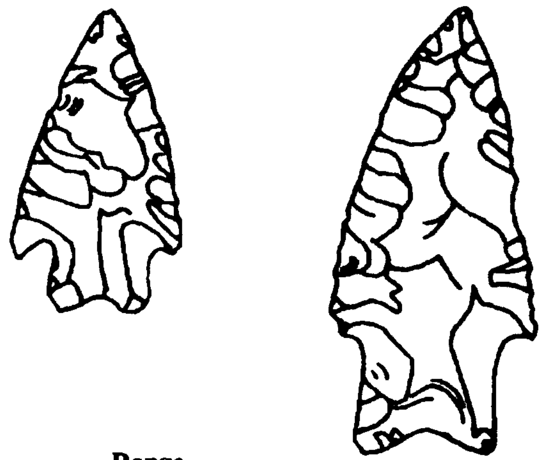
Temporal: In Todsen Cave one Lerma point was found in an Early Archaic level, but the North Mesa site had Lermas in Paleo-Indian levels dating before 7000 B.C. In nearby Texas they also appear in Archaic and Paleo-Indian levels; however, in many areas they are in Early Paleo-Indian contexts (Turner and Hester 1985).

Spatial: Lerma or similar types occur in the Dyuktai complex in Siberia as well as the Putu and Flint Creek complexes of Alaska and the Yukon. These could well be the earliest point type(s) in the New World that can be related to Asiatic counterparts (MacNeish 1967). On the Paleo-Indian level in North America these types or similar ones occur in early contexts on the Pacific Coast in British Columbia, coastal sites in Washington, the Dalles in Oregon, and San Dieguito in California (Warren 1967), as well as the Lerma and Ajuereado phases in Mexico. Further, these laurel leaf-shaped points occur in early complexes in the Andes of South America and on the Pacific Coast from Colombia's Tequedama complexes to Chile.

It is uncertain whether all of these points, with their relatively simple forms that are easily duplicated, are the

same type or related types. This uncertainty presents a major difficulty in plotting relationships on the basis of present data, although future researchers may determine the Lerma point is a very significant type, perhaps one of the most significant on the earliest levels.

TYPE: PEDERNALES-BAKER



Source of Drawings: Todsen Collection, from surface of White Sands, NM

Sample

Excavation	0
Surface	2
Pictorial	8
Total	**10**

Description (based on a sample of 2)

Dimensions (in mm)

	Mean	**Range**
Maximum length	52.10	41.7-62.5
Maximum width	25.85	23.7-28.0
Maximum thickness	6.25	5.10-7.40
Tip to maximum body width	39.25	33.5-45.0
Body length	39.25	33.5-45.0
Body width	25.85	23.7-28.0
Notch depth R.	3.55	3.30-3.80
Notch depth L.	3.70	3.20-4.20
Stem length	8.15	6.10-10.2
Stem distal width	15.00	12.3-17.7
Stem proximal width	15.90	13.6-18.2
Base width	15.90	13.6-18.2

Form and Chipping Technique

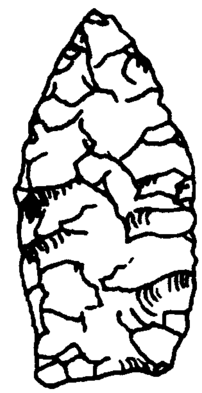
Tip: Acute convex (100%). Fine percussion (75%), and crude percussion (25%).
Body: Converging convex (100%). Fine percussion (75%), and rippled percussion (25%).
Edges: Fine percussion (50%), and crude pressure (50%).
Shoulder: Sharply acute angled (50%), and concave expanding (50%).
Notch: Concave oblique (50%), and concave acute (50%) after a bifacial single percussion blow.
Stem: Straight parallel (50%), and concave expanding (50%). Crude percussion (100%).
Edges: Crude percussion (87.5%), and fine percussion (12.5%).
Basal junction: Eared rounded (50%), and acute rounded (50%).
Base: Notched convex (50%), and deeply concave (50%). Crude percussion (100%).

Relationships

Temporal: The Pedernales-Baker basically is a Texas type (or types) that began in Early Archaic times as Baker (Shafer 1980) and lasted into Middle Archaic times as Pedernales (Turner and Hester 1985). In the Jornada region it seems to date to early Middle Archaic times–Keystone phase, roughly 4500 to 2600 B.C. (Leslie 1978).

Spatial: This point's main distribution is southwest Texas but it seems to extend up the Rio Grande to the Jornada area. It or related types also may extend down the Gulf Coast of Mexico as far south as Belize.

TYPE: BAT CAVE



Source of
Drawing: Todsen Collection, from White Sands, NM

Sample

Excavation	1
Surface	2
Pictorial	8
Total	**11**

Description (based on a sample of 3)
Dimensions (in mm)

	Mean	Range
Maximum length	49.5	32.0-55.0
Maximum width	23.1	20.0-35.0
Maximum thickness	3.8	0.80-4.20
Tip to maximum body width	49.5	27.0-40.0
Body length	49.5	32.0-55.0
Body width	23.1	20.0-35.0
Base width	23.1	13.0-33.0

Form and Chipping Technique

Tip: Acute convex (100%). Fine percussion (100%).

Body: Parallel converging (50%), and parallel sinuous (50%). Dorsal and ventral surfaces show crude percussion (100%). Body sides show fine percussion (75%), and crude percussion (25%).

Basal junction: Right angle rounded (50%), and eared (50%).

Base: Slightly concave (100%). Crude percussion (100%).

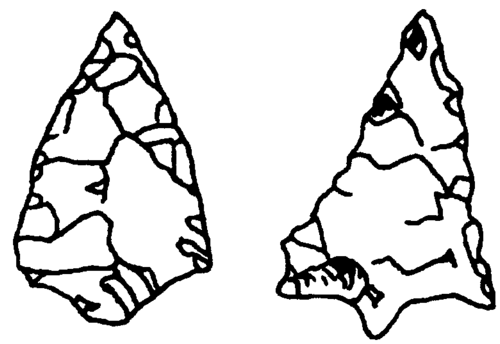
Relationships

Temporal: In Todsen Cave, Bat Cave points were found in zone K–Keystone phase, dated in the range of 4500 to 2500 B.C. One made of obsidian from the Tularosa Basin dated at 3100 B.C. Reputedly they were found under Chiricahua remains in Bat Cave, but the stratigraphy was not very reliable (Dick 1965).

Spatial: This type is relatively common in the Jornada region, but our sample is so small that the type is not well defined. It seems to extend into the Mogollon Mountain area, but seems absent farther west in the Gila Drainage of Arizona (Haury 1950) and in the Colorado Plateau with its Oshara tradition (Wendorf and Miller 1959). Eastward toward Texas it also seems absent, although Plainview, Milnesand, and Kenney might be related.

TYPE: GYPSUM-ALMAGRE

Sources of
Drawings: Left, Todsen Cave zone K;
right, Todsen Collection, from White Sands, NM



Sample

Excavation	2
Surface	3
Pictorial	12
Total	**17**

Description (based on a sample of 4)
Dimensions (in mm)

	Mean	Range
Maximum length	42.50	34.0-53.0
Maximum width	24.60	21.0-27.0
Maximum thickness	4.30	3.00-5.50
Tip to maximum body width	38.40	30.0-48.0
Body length	38.00	30.0-48.0
Body width	25.40	21.0-26.0
Notch depth R.	2.16	2.30-3.00
Notch depth L.	2.16	2.30-3.00
Stem length	6.20	4.00-8.00
Stem distal width	11.00	6.00-16.0
Stem proximal width	3.00	1.00-5.00
Base width	3.00	1.00-5.00

Form and Chipping Technique

Tip: Acute convex (60%), acute straight (30%), and acute concave (10%). Crude pressure chipping both dorsal and ventral (100%).

Body: Converging convex both dorsal and ventral (100%). Dorsal and ventral sides show crude percussion (80%), and fine percussion (20%). Edges show crude pressure (60%), fine pressure (20%), and crude percussion (20%).

Shoulder: Acute angled (60%), acute rounded (20%), and obtuse angled (20%).

Notch: Oblique concave (80%), and oblique sharp (20%).

Stem: Contracting concave (40%), contracting straight (40%), and contracting convex (20%). Stem body is crude percussion (100%). Stem edges about evenly divided between crude pressure (51%), and fine pressure (49%).

Basal junction: Usually obtuse rounded (80%), remainder acute angled (20%).

Base: Pointed (90%), and deeply convex (10%). Crude pressure (70%), fine pressure (20%), and crude percussion (10%).

Relationships

Temporal: One Gypsum-Almagre from Todsen Cave was in zone K next to the bone that C14 dated at 3669 B.C., while others have been found in Keystone phase sites dating between 4500 and 2500 B.C. We still, however, need more well-dated specimens (Turner and Hester 1985).

Spatial: Like other Keystone types, Gypsum-Almagre points have affiliations westward to southern Arizona (Haury 1950; Campbell 1935) and the deserts of California in the Gypsum-Amargosa I-II complexes to the lower Rio Grande and into northeast Mexico–Coahuila (some Espantosa points, Taylor 1966), Nuevo Leon (Epstein 1963), and Tamaulipas (MacNeish 1958). Strangely enough, they do not seem to occur in the Mogollon Rim but in Colorado Pla-

teau regions to the north. Although not recorded for the Oshara tradition in the Colorado Plateau, this type does occur with the Deshe complex north of Navajo Mountain and in fact, it could well occupy the period between Bajada and San Jose (Lindsay et al. 1968; Parry and Christensen 1987).

TYPE: AMARGOSA-PINTO

Source of
Drawings: Todsen Collection, from White Sands, NM

Sample

Excavation	7
Surface	11
Pictorial	23
Total	**41**

Description (based on a sample of 13)

Dimensions (in mm)

	Mean	Range
Maximum length	32.85	29.0-42.0
Maximum width	18.83	16.0-23.0
Maximum thickness	5.50	5.00-7.00
Tip to maximum body width	27.00	22.0-32.0
Body length	27.00	22.0-32.0
Body width	19.20	16.0-25.0
Notch depth R.	2.06	0.50-4.00
Notch depth L.	2.06	0.50-4.00
Stem length	8.90	5.00-11.0
Stem distal width	14.35	12.0-20.0
Stem proximal width	17.95	13.0-22.0
Base width	17.45	13.0-20.0

Form and Chipping Technique

Tip: Acute convex (85%), and acute straight (15%). Crude pressure (80%), dorsal and ventral edges, fine pressure (15%), and crude percussion (5%).

Body: Converging convex (90%), and converging straight (10%). Chipping on body is crude percussion (100%). Usually edges serrated (90%), the remainder show crude percussion (10%), giving a notched appearance.

Shoulder: Angles are acute rounded (50%), obtuse angled (20%), obtuse rounded (20%), and acute angled (10%).

Notch: Oblique concave (80%), acute concave (15%), and acute sharp (5%).

Stem: Expanding concave (80%), and expanding convex (20%). Stem body, both dorsal and ventral, shows crude percussion (100%). Edges of stem show crude pressure (95%), and crude percussion (5%).

Basal junction: Angles vary from acute rounded (50%), acute angled (25%), eared (20%), obtuse rounded and right angled (5%).

Base: Slightly concave (80%), and deeply concave (20%), with crude pressure chipping, dorsal and ventral (80%), and fluted or thinned (20%).

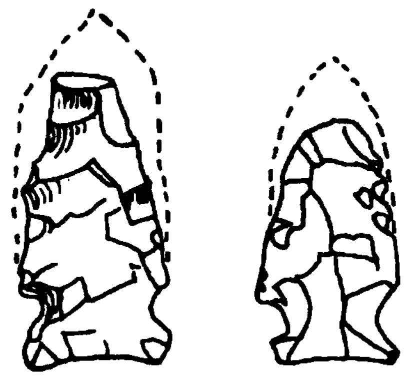
Relationships

Temporal: In the Jornada region and the excavation in Todsen Cave this Amargosa-Pinto type seems diagnostic of

the Keystone phase–roughly 4500 to 2500 B.C. In Ventana Cave (Haury 1950) and California (Campbell and Campbell 1935; Rogers 1939) it seems present perhaps in the late part of this range as it does in the San Jose complex of central New Mexico (Lindsay et al. 1968· Bryan and Toulouse 1943).

Spatial: This point extends from the Arroyo Cuervo (Irwin-Williams 1973 and 1979), Black Mesa, and Jornada region of New Mexico on the east (Leslie 1978), westward to the southern California desert region. It may be related to Darl and Fairland in south Texas (Turner and Hester 1985), but related types seem absent in the Big Bend area of Texas and Coahuila.

TYPE: TODSEN



Sources of Drawings: Left, Todsen Cave, zone I; right, Todsen Collection, from White Sands, NM

Sample

Excavation	8
Surface	4
Pictorial	12
Total	**24**

Description (based on a sample of 13)

Dimensions (in mm)

	Mean	Range
Maximum length	33.40	40.0-60.0
Maximum width	20.20	17.0-26.0
Maximum thickness	5.90	5.00-8.00
Tip to maximum body width	25.50	28.0-40.0
Body length	25.50	28.0-40.0
Body width	20.10	17.0-26.0
Notch depth R.	3.25	2.00-4.00
Notch depth L.	3.25	2.00-4.00
Stem length	8.10	6.00-13.0
Stem distal width	14.20	10.0-17.0
Stem proximal width	18.30	17.0-22.0
Base width	19.40	17.0-22.0

Form and Chipping Technique

Tip: Acute convex with crude percussion chipping (100%).

Body: Converging convex (75%), and parallel convex (25%). Body chipping, dorsal and ventral, crude percussion (100%). Body edges repeat crude pressure (98%) and crude percussion (2%).

Shoulder: Right angle rounded (30%), acute angled (25%), acute rounded (25%), obtuse rounded and acute angled making up the other 20%.

Notch: Acute concave (90%), and oblique concave (10%).

Stem: Expanding convex (50%), and expanding concave (50%). Stem body is crude percussion (100%). Stem edges show crude percussion (70%), crude pressure (20%), and fine pressure (10%).

Basal junction: Right angle rounded (40%), right angled (30%), eared (20%), and obtuse rounded (10%).

Base: Expanding convex (65%), and straight (35%). Crude pressure (85%), thinned (10%), and ground (5%).

Relationships

Temporal: This Todsen type at Todsen and North Mesa occurs in late Keystone and Early Fresnal levels, roughly from 3500 to 2000 B.C. An obsidian Todsen from level 7 of Roller Skate gave a date of 3095 B.C. Reputedly Todsen points occurred in the Chiricahua level at Bat Cave at about this time period, but better dating is needed.

Spatial: The Todsen type is rather distinctive for the Jornada region, and one was reported from Bat Cave in the Mogollon Rim (Dick 1965). However, they are absent from Chiricahua remains in the Gila (Martin et al. 1952) as well as in the Colorado Plateau, and no type in Texas seems related, although a few Ensor are vaguely similar (Turner and Hester 1985:94). A few from northeast New Mexico at Sangre de Cristo (Wendorf and Miller 1959) and some from Magic Mountain and LoDaiska (Irwin-Williams and Irwin 1966) in eastern Colorado seem related, but again more good contextual data are needed.

TYPE: PELONA

Source of
Drawing: Todsen Cave

Sample

Excavation	3
Surface	8
Pictorial	23
Total	**34**

Description (based on a sample of 11)

Dimensions (in mm)

	Mean	**Range**
Maximum length	39.89	23.0-60.0+
Maximum width	18.44	13.0-23.0
Maximum thickness	6.55	5.00-8.00
Tip to maximum body width	26.55	21.0-31.0
Body length	27.00	21.0-31.0
Body width	18.11	13.0-24.0
Stem length	18.33	8.00-38.0
Stem distal width	14.55	11.0-21.0
Stem proximal width	5.44	3.00-8.00
Base width	5.00	3.00-8.00

Form and Chipping Technique

Tip: Acute convex (90%), and acute straight (10%). Crude pressure chipping (100%).

Body: Converging convex form (90%), and converging straight (10%). Both dorsal and ventral surfaces show crude percussion chipping. While edges have been modified by crude pressure (90%), the remainder show some serration and occasionally crude percussion.

Shoulder: Obtuse rounded (65%), and obtuse angled (35%).

Notch: One oblique concave notch only, but mainly (90%) without notch usually 1/2 to 1/3 length of whole point.

Stem: Contracting convex (90%), and contracting concave (10%). Stem body shows crude percussion chipping (100%), dorsal and ventral. Most edges subjected to crude pressure (85%), others show crude percussion, fine percussion, and grinding (15%).

Basal junction: All basal junctions are oblique rounded (100%).

Base: Usually pointed (70%), with some deeply convex (30%). Chipping is crude pressure (80%), crude percussion (10%), and fine pressure (10%).

Relationships

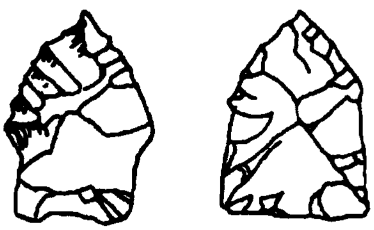
Temporal: As far as excavations go, Pelona points seem to have a fairly long lifespan, for they occur in Keystone levels–4500-2500 B.C.–as well as Early Fresnal levels–2500-1500 B.C.

Spatial: In the Mogollon Mountains they occur in the Chiricahua phase sites of Ake (Beckett 1973; Dick 1965). They also occur in Chiricahua sites in the Gila Drainage in Arizona (Sayles 1983). At Ventana Cave they occur in the middle deposits of Chiricahua-Amargosa II times (Haury 1950) and in California are part of the Mohave complex. In Texas (Turner and Hester 1985:87) the Desmuke type seems related; while such types are more popular in the Big Bend area, they also occur in Coahuila and Nuevo Leon (Taylor 1966) and may extend into central Mexico (MacNeish 1967).

The Pelona type blends into the Gypsum-Almagre type and may be a later manifestation of this tradition.

TYPE: SAN JOSE

Source of
Drawings: Todsen Cave



Sample

Excavation	10
Surface	15
Pictorial	5
Total	**30**

Description (based on a sample of 11)

Dimensions (in mm)

	Mean	**Range**
Maximum length	37.45	32.0-45.0
Maximum width	20.70	14.5-2.70
Maximum thickness	5.62	3.00-7.00
Tip to maximum body width	23.87	14.1-32.0
Body length	26.63	17.0-32.0
Body width	19.40	14.5-22.6
Notch depth R.	2.82	1.80-6.00
Notch depth L.	2.43	00.2-5.00
Stem length	10.98	8.90-14.0
Stem distal width	13.89	10.2-16.8
Stem proximal width	16.68	11.0-27.0
Base width	16.58	11.0-27.0

Form and Chipping Technique

Tip: Acute convex form (100%). Crude percussion (40%), crude pressure (30%), and fine pressure (30%).

Body: Converging convex (90%), and converging straight (10%). Crude percussion (100%), dorsal and ventral body. Body edges show crude pressure (60%), fine pressure (30%), crude percussion (5%), and fine percussion (5%).

Shoulder: Obtuse rounded (60%), obtuse angled, acute angled, sharply acute rounded, acute and right angle rounded make up the remaining 40%.

Notch: Oblique concave (95%), and acute sharp (5%), made by percussion blows.

Stem: Expanding convex (60%), expanding concave (30%), and parallel straight (10%). Stem body is crude percussion (100%), both dorsal and ventral. Edges show crude pressure (60%), fine pressure (30%), and crude percussion (10%).

Basal junction: Obtuse rounded (55%), acute rounded (40%), and acute angled (5%).

Base: Base forms include V-shaped (30%), deeply concave (30%), slightly concave (20%), notched (10%), and deeply convex (10%). Chipping shows fluting or thinning (50%), crude pressure (30%), and grinding 20%.

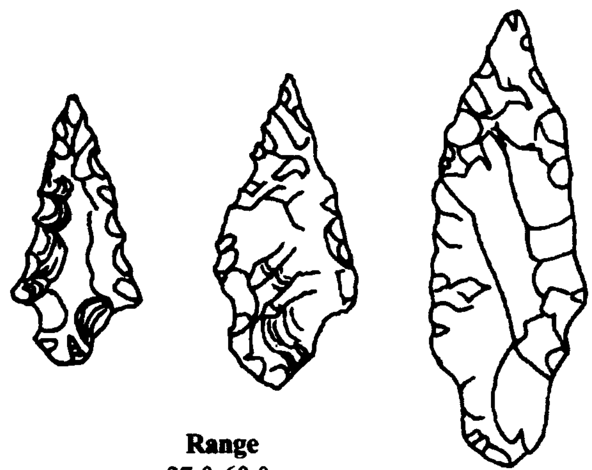
Relationships

Temporal: San Jose points obviously are related closely to the Amargosa-Pinto type (Campbell and Campbell 1935), but in our definition lack the serrated body edges and the sharp acute basal stem junctions. Further, in our stratigraphic levels in both Todsen and North Mesa they seem to follow, and perhaps develop from, the Amargosa-Pinto type and fall mainly in the Fresnal period–2500 to 900 B.C.–although surface collections hint the type may last into Hueco times. Better dating clearly is needed.

Spatial: The greatest distribution of these points is in central New Mexico at the southern edge of the Colorado Plateau in the San Jose phase (Irwin-Williams 1973 and 1979; Hunt and Tanner 1960; Thoms 1977; Wendorf and Miller 1959; Wendorf and Thomas 1951; Parry and Christensen 1987; Lindsay et al. 1968). They also occur in Chiricahua phase sites in the Mogollon Mountains (Dick 1965; Martin et al. 1952) and Gila Drainage (Haury 1950; Sayles 1983) and blend into the Amargosa-Pinto complex in southern California. To the east they may be related to the Gower and Paisano complexes of southern Texas, but the resemblances are not striking (Turner and Hester 1985). Again to the northwest and the Plains, the H type might be related, but there are not enough data to establish a firm connection.

TYPE: AUGUSTIN

Source of Drawings: Todsen Cave, zone J



Sample

Excavation	11
Surface	10
Pictorial	27
Total	**48**

Description (based on an adequate sample of 20)

Dimensions (in mm)

	Mean	Range
Maximum length	44.22	27.0-60.0
Maximum width	21.26	16.0-27.0
Maximum thickness	6.53	5.00-10.0
Tip to maximum body width	33.51	20.0-53.5
Body length	34.95	23.6-53.5
Body width	21.03	15.5-30.0
Notch depth R.	2.56	1.00-5.50
Notch depth L.	2.60	1.00-5.50
Stem length	9.74	7.00-19.0
Stem distal width	11.89	8.50-14.0

	Mean	Range
Stem proximal width	12.29	6.00-12.0
Base width	7.48	5.60-10.3

Form and Chipping Technique

Tip: Acute convex (70%), and acute straight (30%), with crude pressure (80%), fine pressure (10%), and crude percussion (10%).

Body: Converging convex (90%), and converging straight (10%). Both dorsal and ventral surfaces show crude percussion (100%). Body edges show crude pressure (60%), serration (30%), and crude percussion and fine pressure (10%).

Shoulder: Obtuse rounded (45%), acute rounded (25%), acute angled (20%), right angle rounded (5%), and obtuse angled (5%).

Notch: Oblique concave (95%), and acute concave (5%).

Stem: Contracting convex (95%), and contracting straight (5%). Stem body shows crude percussion (100%). Stem edges show crude pressure (75%), fine pressure (15%), and crude percussion (10%).

Basal junction: Obtuse rounded (100%).

Base: Deeply convex (65%), slightly convex (30%), and straight and pointed (5%). Usually crude pressure (90%) with crude percussion, fine pressure, and thinning making up 10%.

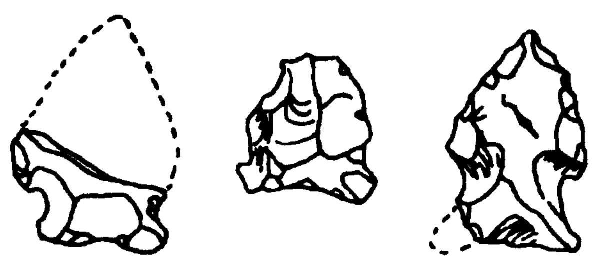
Relationships

Temporal: Augustin points mainly occur in the Fresnal phase, dated from 2500 to 900 B.C., and occur at the AKE site (Beckett 1973; Dick 1965) in the Mogollon Mountains and in Chiricahua sites in the Gila at about the same time (Sayles 1983).

Spatial: These types occur from the Jornada region across southern Arizona (Haury 1950) to the California desert, where they seem to die out. They also seem not to be popular in the Colorado Plateau to the north (Wendorf and Thomas 1951), but may well be the Manzano type from the mountains of the same name (Hibben 1941). To the east they seem related to Gary of east and south Texas, but the lack of this type in west and central Texas as well as in the Big Bend casts doubt upon the relationship (Turner and Hester 1985:101). Some of the Gobernador and Jora points of Coahuila (Taylor 1966) as well as the Gary-like points in Tamaulipas (MacNeish 1958) and farther south in Mexico could be related (MacNeish 1967), but more data are necessary before a definite relationship can be established.

TYPE: CHIRICAHUA

Sources of
Drawings: Todsen Cave: left and center, zone J; right, zone πJ



Sample

Excavation	10
Surface	16
Pictorial	17
Total	**43**

Description (based on an adequate sample of 18)

Dimensions (in mm)

	Mean	Range
Maximum length	25.56	19.0-28.5

	Mean	Range
Maximum width	17.10	12.0-22.5
Maximum thickness	5.00	3.60-7.80
Tip to maximum body width	16.74	7.50-23.5
Body length	18.40	11.0-26.9
Body width	15.90	12.0-22.0
Notch depth R.	1.80	1.00-4.30
Notch depth L.	1.80	1.00-4.30
Stem length	7.26	3.00-10.0
Stem distal width	13.25	9.00-18.0
Stem proximal width	15.87	10.0-22.0
Base width	16.68	11.4-22.5

Form and Chipping Technique

Tip: Oblique convex (55%), acute convex (40%), and oblique straight (5%). Crude pressure (80%), fine pressure (10%), and crude percussion (10%).

Body: Converging convex(95%), and converging straight (5%). Dorsal and ventral surfaces show crude percussion (95%), and fine percussion (5%). Edges usually are crude percussion (80%), with fine percussion (10%) and fine pressure (10%).

Shoulder: Obtuse rounded (50%), right angle rounded (30%), obtuse angled (10%), and acute rounded (10%).

Notch: Oblique concave (75%), and acute concave (25%).

Stem: Expanding convex (100%). Stem body shows crude percussion (95%) and crude pressure (5%). Stem edges show crude pressure (45%), crude percussion (25%), fine pressure (15%), serrated (5%), and other (10%).

Basal junction: Usually eared (80%). Obtuse rounded, acute rounded, right angle rounded, and obtuse angled 5% each.

Base: Slightly convex (45%), slightly concave (35%), and deeply concave (20%). Crude pressure (50%), crude percussion (25%), ground (10%), thinned (10%), and fine pressure (5%).

Relationships

Temporal: In Todsen Cave these Chiricahua types were confined to the Fresnal phase, dated between 2500 and 900 B.C. There are, however, hints that farther west–in Chiricahua–they might occur a little earlier, while to the north–in Armijo–they might be slightly later (Irwin and Irwin 1959; Parry and Christensen 1987, plates 5c and e, 6e, 7m, etc.), but a definite assessment will have to wait for better dating.

Spatial: These are widespread in southern Arizona (Sayles 1983) and New Mexico (Dick 1965; Martin et al. 1952) and appear in the Colorado Plateau in the Armijo complex (Irwin-Williams 1979) as a minority type. In south and central Texas the Frio type may be related (Turner and Hester 1985:100), but such does not occur in west Texas (Leslie 1978) while in the Big Bend area they are replaced by the Paisano type (Shafer 1986; Hester 1980). In California, some of the Pinto types are similar, but relationships seem tenuous (Haury 1950).

TYPE: LA CUEVA

Sources of
Drawings: Left, Todsen Collection, from White Sands, NM;
right, Todsen Cave, zone J1

Sample

Excavation	15
Surface	8
Pictorial	4
Total	**27**

Description (based on a sample of 27)

Dimensions (in mm)

	Mean	Range
Maximum length	22.14	16.7-32.0
Maximum width	17.95	00.5-25.0
Maximum thickness	5.75	3.40-8.00
Tip to maximum body width	14.44	7.70-23.0
Body length	14.24	7.70-21.0
Body width	14.70	13.5-25.0
Notch depth R.	2.17	1.00-4.00
Notch depth L.	2.17	1.00-4.00
Stem length	8.63	6.00-12.0
Stem distal width	12.73	8.60-19.2
Stem proximal width	17.72	12.0-25.0
Base width	17.89	12.0-25.0

Form and Chipping Technique

Tip: Usually oblique convex (60%) or acute convex (30%), some acute straight and oblique straight (10%). Chipping mostly crude pressure (80%), with fine pressure and crude percussion about equal (20%).

Body: Form is converging convex (80%) and converging straight (20%). Mixed chipping technique–crude percussion (50%), crude pressure (20%), remainder divided between fine pressure, dorsal and ventral and edges usually short and stubby.

Shoulder: Usually obtuse rounded (80%), or obtuse angled (10%), remainder divided between acute angled and acute rounded (10%).

Notch: Acute concave (50%), oblique concave (40%), and oblique sharp (10%).

Stem: Generally expanding convex (90%), remainder expanding straight or concave (10%). Stem body shows crude percussion (90%), and crude or fine pressure (10%). Stem edges reflect crude percussion (45%), crude pressure (15%), fine pressure (15%), some grinding (20%), and other (5%).

Basal junction: Obtuse rounded (80%), acute rounded (10%), and eared (10%).

Base: Slightly convex (90%), remainder deeply convex and occasionally straight. Crude pressure (50%), crude percussion (20%), ground (20%), and fluted or fine pressure (10%).

Relationships

Temporal: This type, both from La Cueva as well as Todsen Cave, seems to belong to the Fresnal phase, from 2500 to 900 B.C.

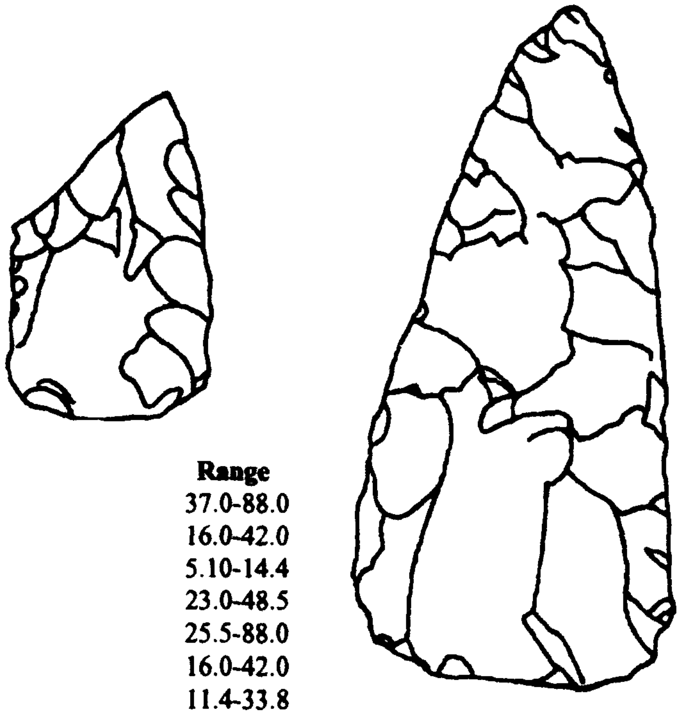
Spatial: Although this type in the Jornada region (Cosgrove 1947) seems related to the Chiricahua type, it is surprising to find that it does not occur in Chiricahua sites in the Mogollon Rim (Dick 1965; Martin et al. 1952) or the Gila Drainage or in California. A few points in the Armijo may be related, but the similarities are not striking (Parry and Christensen 1987, plate 5d), nor is this similar type very numerous. In the Big Bend area some Figueroa points are similar (Shafer 1986), but they seem later in time, as do the similar Ensor types farther east (Turner and Hester 1985:94). From many standpoints this type is diagnostic of and unique to the Jornada region at this time period.

TYPE: NOGALES

Sources of
Drawings: Todsen Cave: left, zone J;
right, zone πJ

Sample

Excavation	14
Surface	6
Pictorial	3
Total	**23**



Description (based on a sample of 14)
Dimensions (in mm)

	Mean	Range
Maximum length	50.45	37.0-88.0
Maximum width	26.58	16.0-42.0
Maximum thickness	8.81	5.10-14.4
Tip to maximum body width	36.32	23.0-48.5
Body length	48.18	25.5-88.0
Body width	26.58	16.0-42.0
Base width	21.56	11.4-33.8

Form and Chipping Technique

Tip: Acute convex (70%), oblique convex (30%); crude pressure (75%), and crude percussion (25%).

Body: Converging convex (80%), converging straight (10%), and parallel straight (10%). Dorsal and ventral surfaces show crude percussion (100%). Body sides show crude percussion (35%), crude pressure (35%), and fine pressure (30%).

Basal junction: Obtuse rounded (80%), and right angle rounded (20%).

Base: Slightly convex (100%). Crude pressure (60%), and crude percussion (40%).

Relationships

Temporal: The Nogales point is a generalized type that probably had a number of functions–as knife blades, quarry blanks (Guernsey and Kidder 1921) and only occasionally projectile points–so it is not surprising that it had a long life span lasting up to modern times. So far the earliest ones we have found are in the Fresnal phase, but future excavation may well find earlier ones (Dick 1965)

Spatial: Needless to say, these are widespread in the Southwest and elsewhere (Haury 1950; Irwin-Williams 1973; Wendorf and Thomas 1951).

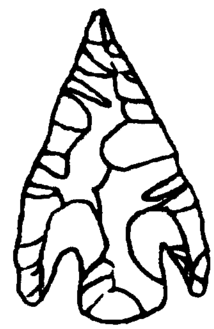
TYPE: SHUMLA-LIKE

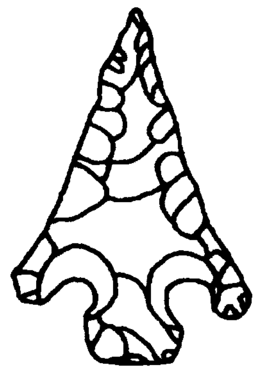
Source of
Drawings: Todsen Collection, from White Sands, NM (see next page)

Sample

Excavation	0
Surface	5
Pictorial	8
Total	**13**

SHUMLA-LIKE





Description (based on a sample of 5)
Dimensions (in mm)

	Mean	Range
Maximum length	41.12	39.5-43.0
Maximum width	30.28	26.0-30.0
Maximum thickness	5.30	5.00-6.20
Tip to Maximum body width	33.50	31.0-35.0
Body length	34.75	33.0-38.0
Body width	30.40	26.0-33.0
Notch depth R.	8.80	8.00-11.0
Notch depth L.	6.50	6.00-7.00
Stem length	9.28	8.20-10.0
Stem distal width	11.30	9.00-13.0
Stem proximal width	13.10	10.0-15.0
Base width	13.10	9.00-16.0

Form and Chipping Technique

Tip: Acute convex (50%), and acute straight (50%). Crude pressure chipping (60%), and crude percussion (40%).

Body: Converging convex (60%), converging straight (30%), and converging concave (10%). Crude percussion chipping on both ventral and dorsal surfaces (100%). Body sides show fine pressure (40%), crude pressure (30%), and crude percussion (10%).

Shoulder: Acute rounded basal (60%), sharply acute rounded (30%), and rounded acute (10%).

Notch: Acute concave (60%), acute sharp (20%), oblique concave (20%).

Stem: Expanding concave (70%), expanding convex (15%), and parallel concave (15%). Stem body shows crude percussion (100%). Stem sides also show crude percussion only (100%).

Basal junction: Right angle rounded (60%), acute rounded (30%), and right angled (10%).

Base: Slightly convex (75%), and slightly concave (25%). Crude pressure (30%), fine pressure (30%), ground pressure (30%), and fluted or thinned (10%).

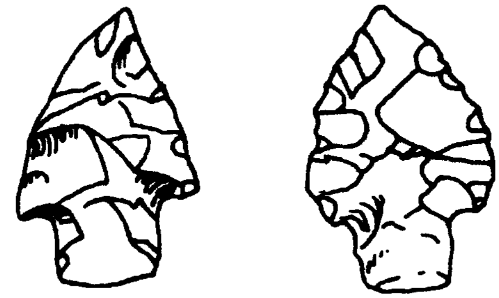
Relationships

Temporal and *Spatial:* Shumla-like points are relatively rare in the Jornada region, and few have come from excavations. Survey data, however, suggest they occur in late Keystone and Fresnal times, 3300-1000 B.C., but in Texas, Hester (Turner and Hester 1985:131) and Shafer (1986:130) would put them in Late Archaic times–c. 1000-200 B.C. Similar points, if not the same type, occur in central Mexico in the 2000-300 B.C. time period. All this evidence suggests they more likely are of the Fresnal-Hueco time period than of Keystone-Fresnal in the Jornada region, but more reliable stratigraphic information is needed.

TYPE: FRESNAL

Sources of
Drawings: Left, Todsen Cave, zone J; right, Todsen Collection, from White Sands, NM (see next page)

FRESNAL



Sample

Excavation	11
Surface	12
Pictorial	3
Total	**26**

Description (based on a sample of 19)

Dimensions (in mm)

	Mean	**Range**
Maximum length	37.28	32.5-45.0
Maximum width	22.42	18.2-27.0
Maximum thickness	6.07	5.00-7.10
Tip to maximum body width	24.73	15.5-34.5
Body length	25.22	19.2-34.5
Body width	23.17	18.2-31.2
Notch depth R.	3.82	1.20-5.20
Notch depth L.	3.23	1.00-5.20
Stem length	10.60	8.00-13.4
Stem distal width	13.84	12.0-16.0
Stem proximal width	11.82	9.10-14.0
Base width	11.87	9.10-14.0

Form and Chipping Technique

Tip: Acute convex (50%), acute concave (25%), and acute straight (25%). Fine pressure (50%), crude pressure (30%), crude percussion (15%), and fine percussion (5%).

Body: Converging convex (60%), and converging straight (40%). Both dorsal and ventral surfaces show crude percussion chipping (100%). Body edges show crude pressure (75%), crude percussion (15%), fine pressure (5%), and fine percussion (5%).

Shoulder: Acute angled (50%), obtuse rounded (20%), right angle rounded (15%), acute rounded (10%), and obtuse angled (5%).

Notch: Oblique concave (80%), and oblique sharp (20%).

Stem: Parallel straight (20%), parallel convex (20%), contracting straight (20%), and expanding concave, expanding straight, contracting convex, and parallel concave each 10%. Stem body shows crude percussion on both dorsal and ventral surfaces (100%). Edges show crude pressure (60%), fine percussion (15%), crude percussion (15%), ground (5%), and fine pressure (5%).

Basal junction: Right angle rounded (60%), obtuse rounded (20%), acute rounded (20%), and obtuse angled and right angled (5%).

Base: Slightly convex (40%), deeply convex (40%), and serrated (20%). Base shows crude pressure (50%), crude percussion (20%), ground edge (15%), fine pressure (10%), and thinning (5%).

Relationships

Temporal: This Fresnal type begins early in the Fresnal phase, roughly 2500 B.C., and lasts into Early Hueco times, roughly 500 B.C.

Spatial: This type is relatively rare in the Southwest and seems to be absent or rare in the Colorado Plateau (Irwin-Williams 1979; Parry and Christensen 1987, plate 5v) and the Mogollon Rim. A few similar points occur in the Chiricahua phase contexts in the Gila (Sayles 1983) and Ventana Cave (Haury 1950), but they are not identical in form, often having more convex bases, so whether this is the same type is difficult to determine. In Texas, Fresnal are most similar to the Carrolton type, but that type appears mainly in east Texas (Turner and Hester 1985:75) and similar forms are absent in the Big Bend region, but not in Coahuila (Taylor 1966).

As of now the Fresnal seems to be a type confined to the Jornada region and thus serves as a rather good Late Archaic time marker.

TYPE: ARMIJO

Source of Drawings: Todsen Cave, zone J

Sample

Excavation	18
Surface	10
Pictorial	5
Total	33

Description (based on a sample of 23)

Dimensions (in mm)

	Mean	Range
Maximum length	33.22	23.0-38.0
Maximum width	16.92	13.5-20.0
Maximum thickness	5.42	4.00-7.00
Tip to maximum body width	25.47	18.0-31.0
Body length	25.57	17.0-31.0
Body width	16.89	13.5-20.0
Notch depth R.	3.47	7.50-16.0
Notch depth L.	3.19	1.00-8.00
Stem length	6.88	0.3-5.00
Stem distal width	10.37	5.00-10.0
Stem proximal width	12.10	8.00-14.0
Base width	12.10	9.00-16.0

Form and Chipping Technique

Tip: Acute convex (50%), acute straight (45%), and acute concave (5%). Dorsal and ventral chipping show fine pressure (80%), and crude percussion (20%).

Body: Converging convex (50%), converging straight (35%), converging sinuous (10%), and parallel straight (5%). Ventral and dorsal sides show crude percussion (50%), crude pressure (45%), and fine pressure (5%). Body edges reflect crude pressure (30%), serration (30%), fine pressure (25%), and crude percussion (15%).

Shoulder: Angles include obtuse rounded (30%), acute angled (30%), acute rounded (20%), right angle rounded (10%), and right angled (5%).

Notch: Acute concave (70%), and oblique concave (30%).

Stem: Expanding concave (85%), expanding straight (10%), and parallel straight (5%). Stem body shows crude pressure (50%), crude percussion (30%), and fine pressure (15%). Stem edges have been modified by crude pressure (45%), crude percussion (35%), and fine pressure (20%).

Basal junction: Obtuse rounded (30%), acute rounded (30%), right angle rounded (15%), obtuse angled (10%), acute angled (10%), and right angled (5%).

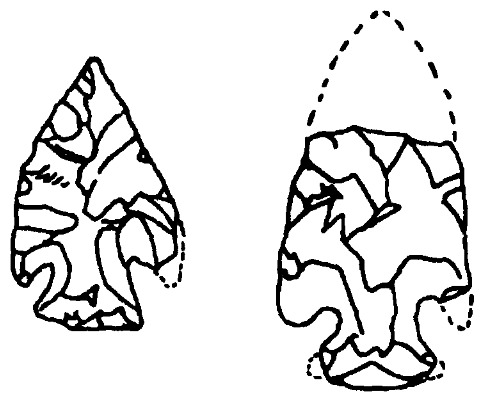
Base: Deeply convex (35%), slightly convex (30%), straight (15%), sinuous (10%), and slightly concave (5%). Crude pressure (65%), fine pressure (25%), crude percussion (10%), and serration (5%).

Relationships

Temporal and *Spatial:* The Armijo type basically is from the Oshara tradition of the Colorado Plateau (Bryan and Toulouse 1943; Thoms 1977, p.109; Irwin-Williams 1973; Irwin and Irwin 1966; Morris and Burgh 1954; Parry and Christensen 1987, plates K and L). It appears mainly in late Fresnal to Early Hueco times in the Jornada area; we suspect the Armijo dates of 1800 to 800 B.C. represent its life span. Similar types do not seem to occur in Texas or the rest of the Southwest (Turner and Hester 1985).

TYPE: HUECO

Source of
Drawings: Todsen Cave, zone πJ



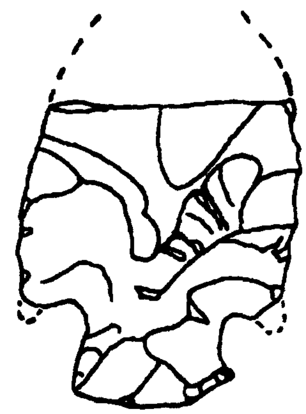
Sample

Excavation	47
Surface	16
Pictorial	17
Total	**80**

Description (based on a sample of 30)

Dimensions (in mm)

	Mean	Range
Maximum length	34.43	12.0-60.0
Maximum width	21.33	7.20-29.0
Maximum thickness	6.25	4.00-9.50
Tip to maximum body width	24.02	4.00-45.0
Body length	24.45	14.5-45.0
Body width	21.96	14.8-29.6
Notch depth R.	4.26	2.00-6.00
Notch depth L.	3.75	.02-6.00
Stem length	9.60	6.00-13.2
Stem distal width	11.63	8.80-16.5
Stem proximal width	14.53	7.50-18.6
Base width	11.40	7.50-18.6



Form and Chipping Technique

Tip: Acute straight (45%), acute concave (45%), oblique concave (5%), and oblique convex (5%). Crude pressure (50%), crude percussion (40%), fine pressure (5%), and fine percussion (5%).

Body: Converging convex (85%), converging straight (10%), and parallel straight and converging concave (5%). Both dorsal and ventral surfaces show crude percussion (95%) with fine percussion and crude pressure making up 5%. Edges reflect crude pressure (55%), fine pressure (35%), crude percussion (5%), and fine percussion (5%).

Shoulder: Acute rounded (25%), right angle rounded (25%), sharply acute rounded (15%), obtuse rounded (15%), acute angled (15%), and obtuse angled (5%).

Notch: Acute concave (60%), oblique concave (30%), oblique sharp (5%), and acute sharp (5%).

Stem: Usually expanding concave (60%), expanding convex (30%), and occasionally expanding straight (10%). Stem body shows crude percussion (85%), crude pressure (10%), and fine pressure (5%). Stem edges reflect crude pressure (60%), crude percussion (20%), fine pressure (10%), and fine percussion (10%).

Basal junction: Obtuse rounded (50%), rounded acute (15%), right angle rounded (10%), obtuse angled (10%), acute angled (10%), and right angled (5%).

Base: Slightly convex (60%), straight (25%), slightly concave (5%), sinuous (5%), and deeply convex (5%). Crude pressure (35%), thinned (30%), fine pressure (15%), crude percussion (15%), and ground (5%).

Relationships

Temporal: The Hueco type, like Hatch, is Late Preceramic to Early Ceramic, 1000 B.C.-A.D. 1000 in excavation at Todsen Cave, La Cueva, and the Organ Mountain rockshelters.

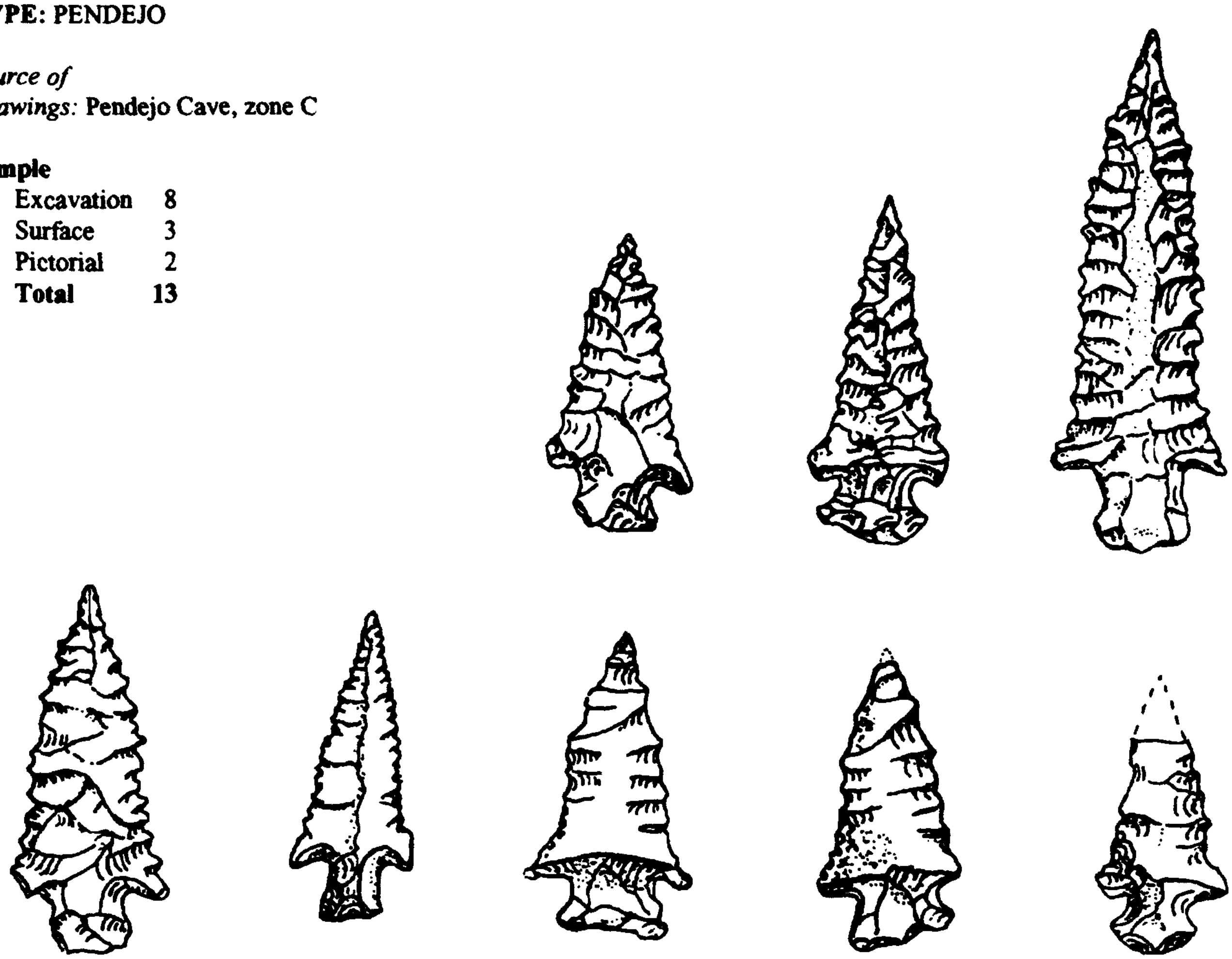
Spatial: The Hueco type occurs in the Jornada region (Cosgrove 1947) as well as in the San Pedro levels of Bat Cave in the Mogollon Rim (Dick 1965). However, it does not seem to occur in San Pedro sites in the Gila Drainage (Martin et al. 1952) or in Ventana Cave (Haury 1950). In En Medio it resembles the En Medio-Palmillas types (Parry and Christensen 1987 plate 5f; Irwin-Williams 1973), but the resemblance is not striking, nor is its resemblance to the corner-notched Marcos and Marshall types of central Texas (Turner and Hester 1985:119). The Hueco thus is a distinctive type for the Jornada region, occupying a definite time period.

TYPE: PENDEJO

Source of
Drawings: Pendejo Cave, zone C

Sample

Excavation	8
Surface	3
Pictorial	2
Total	**13**



Description (based on a sample of 8)

Dimensions (in mm)

	Mean	Range
Maximum length	51.02	41.0-75.0
Maximum width	21.11	18.0-25.0
Maximum thickness	7.31	5.10-8.20
Tip to maximum body width	42.00	33.2-63.7
Body length	42.50	33.2-69.5
Body width	21.00	18.2-25.7
Notch depth R.	5.20	5.10-5.30
Notch depth L.	5.30	3.80-5.80
Stem length	7.50	6.10-10.7
Stem distal width	8.00	7.10-11.4
Stem proximal width	14.10	8.40-15.7
Base width	14.10	9.20-16.1

Form and Chipping Technique

Tip: Acute straight and pressure serrated chipped (100%).

Body surfaces: Crude percussion flaked (100%).

Body edges: Sinuous converging (100%). Dorsal and ventral edges pressure serrated (62%), and crude pressure retouched (35%).

Shoulders: Mainly acute (80%) but some sharply acute (20%) with either crude (50%) or fine (50%) pressure flaking.

Notches: Acute concave (100%) at a 45° angle to the base made by one or two crude percussion blows from opposite surfaces forming them.

Stems: Mainly expanding convex (62%) but some expanding straight (25%). Surfaces crudely percussion flaked as were most of their edges (62%), but a few crude pressure retouched (35%).

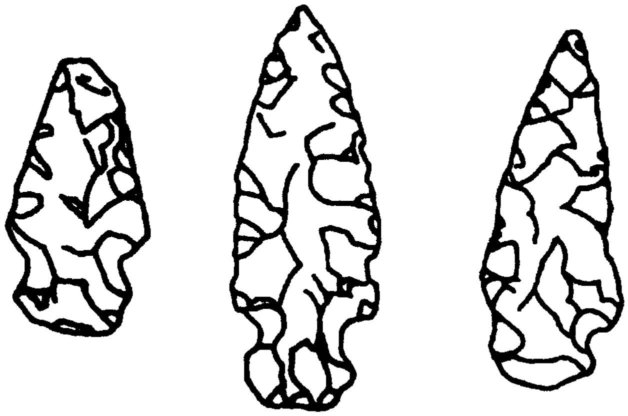
Bases: Slightly convex (62%), deeply convex (12%), straight (12%), and slightly concave (12%). Most crudely pressure flaked (88%).

Relationships

Temporal: Like the related Shumla and Hueco types, these points seem to occur in the general time period from roughly 1000 B.C. to about A.D. 500. In the Jornada region this means they are diagnostics of both the Hueco and Mesilla phases. Surface collections suggest they are most numerous in central Chihuahua and hint that the type might have originated in that region and therefore could be a little earlier in this heartland of the Chihuahua tradition.

Spatial: This type is unknown in the Cochise tradition to the west in both the Hohokam region (Haury 1950) as well as the Mogollon region (Dick 1965). To the north in the Oshara tradition (Irwin-Williams 1973) Thoms suggests the Tesaque narrow base type might be related (Thoms 1977) but the similarities are not striking and they seem generally smaller in size as well as later in time. Some of the Shumlas that have considerable variation (Suhm and Krieger 1954, Plate 119:L,M,S) seem to overlap with our type but the ones Shafer shows for the nearby Big Bend region are different in that they lack the distinctive body edge serrations (Shafer 1986). Pendejo points from surface collections as well as in the pictographs of Las Monas caves in central Chihuahua (Sanchez 1989) indicate this region is the homeland of the type and it, along with Chapalote corn and the distinctive Hueco pictograph style, diffused northward in the millennia before the time of Christ. Hopefully future investigations in Chihuahua will test this hypothesis.

TYPE: SAN PEDRO (large)



Source of
Drawings: Todsen Cave, zone πJ

Sample

Excavation	20
Surface	18
Pictorial	37
Total	75

Description (based on an adequate sample of 26)
Dimensions (in mm)

	Mean	Range
Maximum length	34.92	25.8-46.0
Maximum width	18.50	17.7-29.5
Maximum thickness	6.67	5.80-8.00
Tip to maximum body width	22.91	11.0-31.5
Body length	24.55	13.0-47.0
Body width	18.85	15.6-25.0
Notch depth R.	2.69	1.00-5.50
Notch depth L.	2.91	1.20-4.60
Stem length	10.24	4.00-38.0
Stem distal width	11.91	7.00-16.2
Stem proximal width	14.22	4.50-18.0
Base width	13.96	10.5-18.7

Form and Chipping Technique

Tip: Acute convex (55%), oblique convex (30%), and acute straight (15%). Crude pressure (65%), fine pressure (30%), and crude percussion (5%).

Body: Converging convex (70%), and converging straight (30%). Crude percussion of dorsal and ventral surfaces (95+%). Occasionally fine percussion and crude pressure (5%). Body edges reflect crude pressure (55%), crude percussion (25%), fine pressure (10%), fine percussion (5%), and serration (5%).

Shoulder: Obtuse rounded (35%), obtuse angled (30%), acute rounded (20%), right angle rounded (10%), and acute angled and right angled (5%).

Notch: Oblique concave (60%), acute concave (35%), and oblique sharp (5%).

Stem: Expanding concave (70%), expanding convex (25%), and contracting convex and expanding straight (5%). Stem body shows crude percussion (85%), and crude pressure (15%). Stem edges show crude pressure (45%), crude percussion (35%), fine percussion (10%), and fine pressure (10%).

Basal junction: Obtuse rounded (55%), acute rounded (30%), obtuse angled (5%), right angle rounded (5%), and eared (5%).

Base: Usually slightly convex (80%), deeply convex (5%), pointed (5%), sinuous (5%), and slightly concave (5%). Crude pressure (40%), thinned (35%), crude percussion (20%), and fine percussion and grinding (5%).

Relationships

Temporal and *Spatial:* As its name indicates, the San Pedro is a diagnostic type of the San Pedro phase of the Cochise tradition of the Gila Drainage of southern Arizona (Haury 1950; Sayles 1983) and the Mogollon Rim of New Mexico (Dick 1965; Martin et al. 1952). As such, its time span is about 1000 B.C. to the time of Christ, but in our Jornada region it seems to last into Early Ceramic times–Mesilla phase–and may last to at least A.D. 1000. It also occurs as a minority type in En Medio in the Arroyo Cuervo region of New Mexico (Irwin-Williams 1979) and is related

closely to the Basketmaker II type as well as a companion type in Basketmaker II-III–0 to A.D. 200–in the Colorado Plateau of northern New Mexico and Arizona. As is obvious, it is related closely to San Pedro (small), which is short and proportionally wider, and where one begins and the other ends is difficult to determine. However, the small variety is relatively rare in the Colorado Plateau area and absent in Texas (Turner and Hester 1985), so the distribution shows significant spatial differences.

TYPE: HATCH

Source of
Drawings: Todsen Cave, zone πJ

Sample

Excavation	19
Surface	11
Pictorial	22
Total	**52**

Description (based on a sample of 20)
Dimensions (in mm)

	Mean	**Range**
Maximum length	29.77	23.0-39.0
Maximum width	18.09	10.5-22.8
Maximum thickness	5.30	4.50-9.00
Tip to maximum body width	20.85	12.4-33.5
Body length	21.28	17.0-33.5
Body width	18.39	10.5-22.8
Notch depth R.	3.74	1.30-6.00
Notch depth L.	4.00	2.00-8.00
Stem length	6.19	3.50-11.5
Stem distal width	8.27	7.50-11.5
Stem proximal width	8.87	6.50-12.5
Base width	8.82	6.00-12.5

Form and Chipping Technique

Tip: Acute convex (100%).

Body: Converging convex (50%), converging straight (35%), and some converging straight and parallel straight (15%). Body and edges, ventral and dorsal, mostly modified by fine pressure (75%), crude pressure (15%), remainder serrated (5%), and some crude percussion (5%).

Shoulder: Acute rounded (50%), sharply acute rounded (30%), right angle rounded (10%), acute angled (5%) sharply acute angled (5%).

Notch: Oblique concave (65%), acute concave (35%), often made by bifacial percussion blows.

Stem: Expanding concave (35%), expanding convex (25%), parallel straight (25%), expanding straight (10%), and contracting convex (5%). Stem body crude percussion (100%). Edges, both ventral and dorsal, show crude percussion (65%), fine pressure (30%), and fine percussion (5%).

Basal junction: Obtuse rounded (45)%, right angle rounded (40%), acute rounded (10%), with acute angled, obtuse angled, and right angled comprising 5%.

Base: Slightly convex (60%), and deeply convex (40%).

Relationships

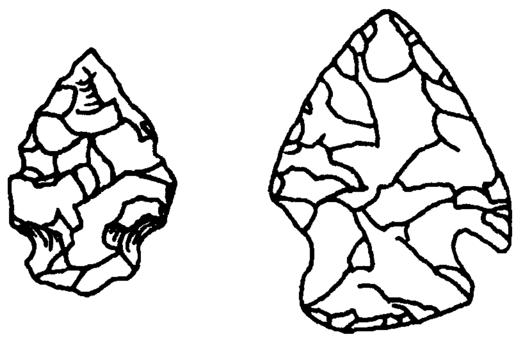
Temporal: The Hatch type occurs in the Late Preceramic, Hueco phase, at roughly 1000 B.C., and lasts through the Mesilla phase, perhaps to A.D. 700.

Spatial: The Hatch is another type confined to the Jornada region (Cosgrove 1947) and is related closely to the Hueco type, but is more limited. It has a different spatial distribution, for the latter occurs at Bat Cave (Dick 1965) in the Mogollon Rim and may be present in En Medio in the Rio Cuervo region of the Colorado Plateau (Irwin 1979; Thoms 1977, p. 88) as a minority type or a variant of En Medio-Palmillas types. In Texas and northeast Mexico this type resembles some narrow, more heavily barbed variants of Palmillas, but the similarities are not striking (Turner and Hester 1985; MacNeish 1958).

Thus the Hatch type not only is a good time marker, but a very good space marker for the Jornada region.

TYPE: EN MEDIO

Source of
Drawings: Todsen Cave, zone πJ



Sample

Excavation	8
Surface	1
Pictorial	6
Total	**15**

Description (based on a sample of 9)

Dimensions (in mm)

	Mean	Range
Maximum length	27.63	19.0-42.5
Maximum width	22.16	16.0-31.0
Maximum thickness	5.41	3.80-7.10
Tip to maximum body width	16.66	12.4-21.0
Body length	19.18	12.4-31.8
Body width	22.16	16.0-31.0
Notch depth R.	3.24	1.00-5.00
Notch depth L.	4.90	3.20-6.20
Stem length	6.98	3.70-11.1
Stem distal width	12.60	8.60-17.2
Stem proximal width	14.30	9.00-21.7
Base width	12.42	9.00-14.0

Form and Chipping Technique

Tip: Acute convex (60%), obtuse convex (30%), and acute concave (10%). Crude pressure (60%), fine pressure (10%), crude percussion (10%), and others (20%).

Body: Converging convex (80%), and converging straight (20%). Body surface, both dorsal and ventral, shows crude percussion (50%), fine pressure (30%), crude pressure (10%), and fine percussion (10%). Body sides show crude pressure (35%), fine pressure (25%), crude percussion (25%), and fine percussion (15%).

Shoulder: Acute rounded (60%), acute angled (25%), and obtuse rounded (15%).

Notch: Acute concave (50%), and oblique concave (50%).

Stem: Expanding convex (60%), and expanding concave (40%). Stem body shows crude pressure (70%), fine pressure (20%), and fine percussion (10%). Stem sides show crude pressure (70%), fine percussion (20%), and crude percussion (10%).

Basal junction: Acute angled (40%), right angle rounded (20%), obtuse rounded (20%), and acute rounded (20%).

Base: Slightly convex (40%), straight (40%), and deeply convex (20%). Crude pressure (50%), fine percussion (30%), thinned or fluted (10%), and fine pressure (10%).

Relationships

Temporal: This is a common type in En Medio and Basketmaker II sites in the Colorado Plateau in the general time period from 800 B.C. to A.D. 1000 or later (Morris and Burgh 1954; Parry and Christensen 1987; Thoms 1977, p.124; Irwin 1979). It seems to have about the same range in the Jornada region.

Spatial: The En Medio type seems to occur in San Pedro of the Mogollon Rim (Martin et al. 1952; Dick 1965), but is rare or absent from this phase farther west in the Gila Drainage (Sayles 1983). In Texas it resembles Ellis and short varieties of Palmillas, but these types do not occur in west Texas or the Big Bend, so there is not a continuous distribution (Turner and Hester 1985:134).

TYPE: BASKETMAKER II

Source of Drawing: Cueva Pintada, Ft. Bliss, NM

Sample

Excavation	0
Surface	5
Pictorial	20
Total	**25**

Description (based on a sample of 5)

Dimensions (in mm)

	Mean	Range
Maximum length	38.0	25.0-52.0
Maximum width	18.0	16.0-30.0
Maximum thickness	7.0	5.00-8.00
Tip to maximum body width	25.0	22.0-43.0
Body length	28.0	
Body width	18.0	
Notch depth R.	3.0	2.00-5.00
Notch depth L.	3.0	2.00-5.00
Stem length	6.5	4.00-9.00
Stem distal width	12.0	9.00-14.0
Stem proximal width	15.0	13.0-17.0
Base width	16.0	14.0-18.0

Form and Chipping Technique

Tip: Acute (100%) with most slightly convex, but some straight. Mainly fine retouching.

Body: Converging straight (about 50%) and convex (about 50%). Edges finely retouched, body surface crude percussion.

Shoulder: Usually rounded and often at right angles to the body, but a few are angled acute or right angled.

Notch: Relatively narrow and deep or U-shaped; very different from the wide notches of San Pedro. Often made by a single percussion blow.

Stem: Usually expanding and very convex.

Basal junction: Varies from acute rounded to eared.

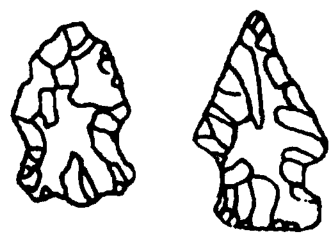
Base: Usually straight, but occasionally very slightly convex.

Relationships

Temporal and *Spatial:* Basketmaker II points are relatively rare in the Jornada region and are known mainly from surface collections of Archaic sites rather than contextural excavation. The few found in surface sites are of the Hueco or Mesilla phases, so the estimate of age of Basketmaker II (En Medio) and Basketmaker III of 800 B.C. to A.D. 700 tentatively is considered the age of the type. The type is most popular in the Colorado Plateau area (Thoms 1977, p. 143; Guernsey and Kidder 1921; Morris and Burgh 1954; Parry and Christensen 1987). It rarely is seen in the Jornada area or the area of the Cochise tradition in southern New Mexico and Arizona. In Texas some of the straight base variants of Ensor are vaguely similar, but establishing a definite relationship is difficult.

TYPE: SAN PEDRO (small)

Source of
Drawings: Todsen Cave, zone πJ



Sample

Excavation	38
Surface	20
Pictorial	9
Total	**67**

Description (based on an adequate sample of 24)

Dimensions (in mm)

	Mean	Range
Maximum length	24.78	16.0-35.0
Maximum width	16.18	13.2-23.0
Maximum thickness	5.57	4.00-33.0
Tip to maximum body width	14.46	11.0-23.0
Body length	15.02	11.0-23.0
Body width	15.56	12.0-20.7
Notch depth R.	1.82	0.4-3.50
Notch depth L.	2.37	0.5-3.60
Stem length	8.71	3.50-12.5
Stem distal width	11.65	8.50-13.0
Stem proximal width	13.55	9.50-19.0
Base Width	13.80	9.50-19.0

Form and Chipping Technique

Tip: Acute convex (40%), oblique convex (20%), acute concave (20%), and acute straight (20%). Crude percussion (45%), fine pressure (30%), and crude pressure (25%).

Body: Converging convex (85%), converging straight (5%), converging concave (5%), and converging sinuous

(5%). Dorsal and ventral surfaces show crude percussion (70%), crude pressure (20%), and fine percussion (10%). Body edges show crude pressure (50%), crude percussion (25%), fine pressure (15%), and fine percussion (10%).

Shoulder: Obtuse rounded (40%), obtuse angled (35%), right angle rounded (20%), and acute rounded (5%).

Notch: Oblique concave (80%), acute concave (10%), and oblique sharp (10%).

Stem: Expanding convex (70%), expanding concave (15%), and expanding straight (15%). Stem body shows crude pressure (50%), crude percussion (45%), and fine percussion (5%). Stem edges show crude pressure (40%), crude percussion (30%), fine pressure (15%), and fine percussion (15%).

Basal junction: Obtuse rounded (60%), right angle rounded (20%), acute rounded (10%), and obtuse angled (10%).

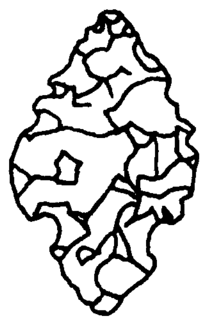
Base: Slightly convex (65%), and deeply convex (35%). Crude pressure (40%), fluted or thinned (35%), fine pressure (15%), and crude percussion (10%).

Relationships

Temporal and *Spatial*: Like San Pedro (large), the San Pedro (small) is a diagnostic of the San Pedro phase–1400 B.C. to A.D. 0–in southern Arizona (Dick 1965; Sayles 1983) and New Mexico (Martin et al. 1952). In our Jornada region it lasts into Ceramic times and still may have been in use at A.D. 1100 or 1200. In the Doña Ana or El Paso phase it is rare or absent from the Colorado Plateau (Bryan and Toulouse, 1943) and is vaguely similar to some of the shorter varieties of Ensor in central Texas and northeast Mexico, but similarities are not marked well (Turner and Hester 1985).

TYPE: MALJAMAR

Source of
Drawing: Todsen Collection
from White Sands, NM



Sample

Excavation	2
Surface	8
Pictorial	10
Total	**20**

Description (based on a sample of 1)

Dimensions (in mm)

	Mean
Maximum length	39.0
Maximum width	25.0
Maximum thickness	6.0
Tip to maximum body width	20.5
Body length	25.0
Body width	25.0
Notch depth R.	2.5
Notch depth L.	4.0
Stem length	11.0
Stem distal width	3.5
Stem proximal width	13.5
Base width	1.6

Form and Chipping Technique

Tip: Oblique convex (100%). Crude percussion both sides (100%).

Body: Converging convex (100%). Crude percussion both dorsal and ventral surfaces. Dorsal and ventral edges are pressure serrated.

Shoulder: Obtuse rounded (50%), and obtuse angled (50%).

Notch: Acute concave (100%).

Stem: Contracting concave (100%). Stem shows crude percussion.

Basal junction: Right angle rounded (100%).

Base: Base is pointed concave and shows crude percussion chipping (100%).

Relationships

Temporal: The Maljamar type is rare in Jornada region sites and the few we have seen seem to be of Early Hueco times, roughly 1000 to 200 B.C. However, there are few good associated dates for the type.

Spatial: This type is most popular in eastern New Mexico in the Roswell-Hobbs region, and may extend into adjacent west Texas (Leslie 1978). However, it is absent in most of the rest of Texas and the rest of the Southwest–Colorado Plateau, Mogollon Rim, and the Gila Drainage. The Maljamar type thus is an extremely good space marker even if present evidence from excavation does not make it a good time marker.

TYPE: PADRE GORDO

Source of
Drawing: Todsen Cave, zone DI

Sample

Excavation	7
Surface	2
Pictorial	3
Total	**12**

Description (based on a sample of 4)

Dimensions (in mm)

	Mean	**Range**
Maximum length	30.0	26.0-42.0
Maximum width	15.0	13.0-22.0
Maximum thickness	4.0	3.00-6.00
Tip to maximum body width	17.0	15.0-21.0
Body length	30.0	26.0-42.0
Body width	15.0	3.00-6.00
Base width	8.0	3.00-9.00

Form and Chipping Technique

Tip: Acute convex (100%). Crude percussion (50%), and crude pressure (50%).

Body: Parallel convex (100%). Crude percussion on dorsal surface. Ventral surface shows rippled percussion. Edges are serrated (75%) and show crude pressure (25%).

Basal junction: Obtuse rounded (100%).

Base: Deeply convex (100%). Chipping shows crude pressure (100%).

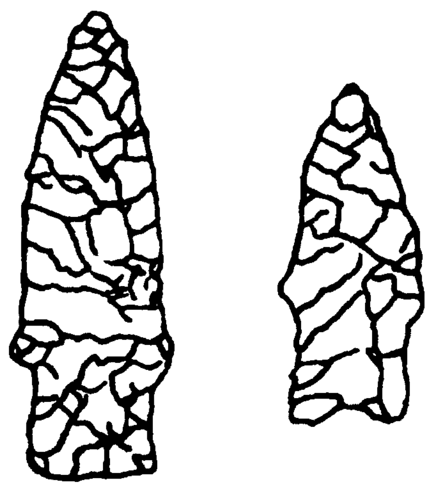
Relationships

Temporal and *Spatial:* This Padre Gordo type represents some problems, not the least of which are inadequate samples from excavated contexts.

At present some are found in Late Preceramic as well as Late Ceramic times, suggesting a 500 B.C. to A.D. 1300 range. A few similar ones occur in En Medio sites in the Colorado Plateau (Irwin 1979); but the greatest similarities are to Padre points on the Texas coast (Turner and Hester 1985:186). However, the point from the Late Preceramic is very thick with crude chipping, while the later one from excavation is thin and finely retouched, so future investigation could subdivide this trial type into two.

TYPE: HOXIE-LIKE

Source of Drawings: Based on Turner and Hester (1985)



Sample

Excavation	2
Surface	3
Pictorial	3
Total	**8**

Description (based on a sample of 1)

Dimensions (in mm)

	Mean
Maximum length	31.6
Maximum width	13.8
Maximum thickness	5.0
Tip to maximum body width	17.6
Body length	17.6
Body width	13.8
Notch depth R.	1.5
Notch depth L.	2.5
Stem length	14.0
Stem distal width	10.0
Stem proximal width	10.6
Base width	10.6

Form and Chipping Technique

Tip: Acute convex (100%). Crude pressure flaking (100%).

Body: Converging convex (100%). Crude pressure flaking on the edge and crude percussion on the surface.

Shoulder: Acute rounded (60%), and right angled (40%), often made by percussion blows bifacially.

Notch: Oblique (50%), or right angled (50%) and concave.

Stem: Straight, bearing pressure retouch on the edge and percussion on the surface (100%).

Basal junction: Roughly right angled (100%).

Base: Straight (50%) to slightly convex (50%); often has a series of thinning (percussion?) flakes removed bifacially.

Relationships

Temporal and *Spatial:* Whether this Hoxie-like type is related to the east Texas Hoxie type (Turner and Hester

1985:106) is debatable, since it occurs only at Ceramic levels from Peña Blanca in the Organ Mountains and surface collections of Mesilla phase sites. It does not appear in other sites in the Southwest.

TYPE: STEINER-LIKE

Source of
Drawings: Based on Turner and Hester (1985)

Sample

Excavation	4
Surface	2
Pictorial	5
Total	**11**

Description (based on a sample of 2)
Dimensions (in mm)

	Mean	**Range**
Maximum length	17.0	15.5-20.15
Maximum width	11.0	9.00-12.0
Maximum thickness	2.8	2.60-2.90
Tip to maximum body width	11.5	11.4-12.45
Body length	11.5	11.4-12.45
Body width	11.0	
Notch depth R.	1.2	1.00-2.00
Notch depth L.	1.3	00.8-1.80
Stem length	5.7	5.25-6.60
Stem distal width	6.0	5.00-7.00
Stem proximal width	7.4	
Base width	7.4	7.20-7.60

Form and Chipping Technique

Tip: Wide acute straight (50%), and oblique straight (50%). Crude pressure (100%).

Body: These points are made on a flake so they have crude percussion flaking on them, but their edges have been pressure retouched, often so strongly they appear serrated.

Shoulder: Acute rounded (100%).

Notch: Acute rounded concave (100%), made by percussion bifacial blows.

Stem: Expanding with straight (50%) or slightly concave (50%) pressure retouched edges. Surface bears crude percussion flake scars.

Basal junction: Acute rounded (100%).

Base: Slightly convex (50%) to slightly concave (50%). Crude pressure retouching.

Relationships

Temporal and *Spatial:* While the Steiner-like type is the same as the east Texas type, it is problematical (Turner and Hester, 1985:191). In the Jornada it occurs mainly in the Mesilla phase (A.D. 300-900); it might last into El Paso times. Similar forms appear in Trujillo times, Pueblo I-II, in the Colorado Plateau, but they are rare or absent in the rest of the Southwest.

TYPE: FRESNO

Source of
Drawing: Todsen Cave, zone C

Sample

Excavation	2
Surface	9
Pictorial	10
Total	**21**

Description (based on a sample of 4)
Dimensions (in mm)

	Mean	Range
Maximum length	19.15	15.5-21.4
Maximum width	12.05	10.5-14.5
Maximum thickness	3.30	3.20-3.50
Tip to maximum body width	19.15	15.5-21.4
Body length	19.15	15.5-21.4
Body width	12.05	10.5-14.5
Base width	12.05	10.5-14.5

Form and Chipping Technique

Tip: Acute straight (100%). Fine pressure (60%), pressure serrated (25%), fine percussion (5%), crude percussion (5%), and crude pressure (5%).

Body: Converging straight (100%). Dorsal and ventral surfaces show crude percussion (70%), and fine percussion (30%).

Shoulder: Acute rounded (60%), right angle rounded (20%), and obtuse angled (20%).

Basal junction: Right angle rounded (65%), eared (20%), and obtuse angled (15%).

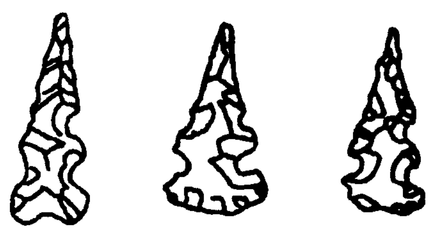
Base: Straight (50%), slightly concave (25%), or slightly convex (25%). Fine percussion (75%), and crude percussion (25%).

Relationships

Temporal and *Spatial*: The Fresno point is the basic arrowpoint type that ultimately came from Asia–perhaps first appearing in the Arctic in Cape Denbigh times around 2000 B.C. It does not appear in the Southwest much before about A.D. 500, but lasts until historic times, perhaps even being used by the Apache.

TYPE: TOYAH

Source of
Drawings: Todsen Cave, zone F+



Sample

Excavation	3
Surface	4
Pictorial	10
Total	**17**

Description (based on a sample of 4)

Dimensions (in mm)

	Mean	Range
Maximum length	20.28	8.00-26.9
Maximum width	10.43	7.00-13.2
Maximum thickness	3.45	2.70-4.50
Tip to maximum body width	16.83	16.5-17.5
Body length	15.83	15.0-17.0
Body width	9.67	9.70-10.5
Notch depth R.	1.50	1.00-2.00
Notch depth L.	1.67	1.50-2.00
Stem length	5.00	2.00-7.00
Stem distal width	8.05	5.20-15.8
Stem proximal width	9.75	4.30-13.2
Base width	9.40	6.10-13.2

Form and Chipping Technique

Tip: Acute straight (100%). Crude pressure (50%), fine pressure (30%), and crude percussion (20%).

Body: Converging straight (50%), and converging concave (50%). Crude percussion (50%), and fine percussion (50%) on dorsal and ventral surfaces. Body edges are pressure notched (55%), and serrated (45%).

Shoulder: Acute rounded (100%).

Notch: Acute concave (70%), oblique sharp (15%), and squared right angled (15%).

Stem: Expanding convex (100%). Stem body shows crude percussion (100%). Stem edges show crude percussion (85%), and crude pressure (15%).

Basal junction: Acute rounded (85%), and eared (15%).

Base: Slightly convex (75%), and notched (25%). Crude percussion (70%), fine pressure (15%), and fine percussion (15%).

Relationships

Temporal: Toyah points occur in Ceramic times in the Jornada region, roughly A.D. 500-1300. They also appear in west Texas about this time (Turner and Hester 1985:193).

Spatial: These are mainly a west Texas type that extends into the Jornada region of New Mexico. They also occur in the Big Bend area (Shafer 1986) of Texas as well as Coahuila (Taylor 1966) in Mexico, but they seem absent in the rest of the Southwest, although some points from the Sacaton phase of Hohokam in southern Arizona resemble them (Gladwin et al. 1937).

TYPE: GARZA

Source of
Drawing: Todsen Cave, zone D

Sample

Excavation	4
Surface	2
Pictorial	4
Total	**10**

Description (based on a sample of 1)

Dimensions (in mm)

	Mean
Maximum length	20.0
Maximum width	8.0
Maximum thickness	2.0
Tip to maximum body width	20.0
Body length	20.0
Body width	8.0
Notch depth L.	3.0
Base width	2.0

Form and Chipping Technique

Tip: Acute straight (100%). Chipping is fine pressure (100%).

Body: Converging straight (100%). Dorsal surface shows fine pressure (100%). Ventral surface shows fine percussion (100%).

Shoulder: Acute rounded basal (100%).

Notch: Acute concave (100%).

Basal junction: Eared (100%).

Base: Deeply convex, almost notched (100%). Fine percussion chipping (100%).

Relationships

Temporal and *Spatial:* The Garza is a basic northwest Texas-Jornada (Turner and Hester 1985:170) regional type. In the latter region it occurs from A.D. 900-1300, and is a good time marker for the El Paso phase.

TYPE: BONHAM-LIKE

Source of
Drawing: Todsen Cave, surface

Sample

Excavation	4
Surface	1
Pictorial	4
Total	**9**

Description (based on a sample of 3)

Dimensions (in mm)

	Mean	Range
Maximum length	76.0	72.0-80.0
Maximum width	18.0	16.0-20.0
Maximum thickness	15.0	14.0-17.0
Tip to maximum body width	13.0	12.0-14.0
Body length	14.5	14.0-13.0
Body width	18.0	17.0-19.0
Notch depth R.	1.0	0.5-1.50
Notch depth L.	2.0	1.50-2.50
Stem length	8.0	7.00-9.00

	Mean	Range
Stem distal width	8.0	7.00-9.00
Stem proximal width	7.0	6.00-8.00
Base width	7.0	6.00-8.00

Form and Chipping Technique

Tip: Broken.

Body: Converging straight (100%). Crude percussion on dorsal and ventral surfaces (100%). Body edges also show crude percussion (100%).

Shoulder: Acute rounded (100%).

Notch: Oblique concave (50%), and acute concave (50%).

Stem: Contracting straight (100%). Crude percussion (100%) on both body and edges.

Basal junction: Right angle rounded (50%); and right angled (50%).

Base: Straight (100%). Dorsal surface shows crude percussion; ventral surface is fluted.

Relationships

Temporal and *Spatial:* It is questionable whether these Bonham-like points of the Jornada region of El Paso times–A.D. 900-1300–are the same as the east Texas Bonham type, or are a variant of the more widespread Perdiz type, or even a separate type (Turner and Hester 1985:165). A roughly similar point occurs in Santa Cruz times of Hohokam in southern Arizona, and an occasional one turns up in Pueblo times in the Colorado Plateau. Obviously more study is needed to determine if all these points are related or are the same type; regardless of their relationship, they are good time markers.

TYPE: ZAVALA

Source of
Drawing: Todsen Cave, zone D2

Sample

Excavation	9
Surface	6
Pictorial	4
Total	**19**

Description (based on a sample of 2)

Dimensions (in mm)

	Mean	Range
Maximum length	21.25	15.5-27.0
Maximum width	14.50	11.0-18.0
Maximum thickness	2.75	2.50-3.00
Tip to maximum body width	19.50	10.0-29.0
Body length	19.50	10.0-29.0
Body width	14.50	11.0-18.0
Notch depth R.	1.25	1.00-1.50
Notch depth L.	1.50	1.00-2.00
Stem length	23.50	12.0-30.0
Stem distal width	39.50	14.0-65.0

	Mean	Range
Stem proximal width	11.5	8.00-15.0
Base width	11.5	8.00-15.0

Form and Chipping Technique

Tip: Acute straight (70%), and acute convex (30%). Crude pressure (50%), crude percussion (25%), and fine pressure (25%).

Body: Converging convex (50%), and converging straight (50%). Both dorsal and ventral surfaces show crude percussion (100%). Body edges show crude pressure (60%), and crude percussion (40%).

Shoulder: Right angle rounded (50%), and obtuse angled (50%).

Notch: Oblique concave (100%).

Stem: Expanding straight (50%), and contracting concave (50%). Stem body shows crude percussion (100%). Edges show crude pressure (65%), and crude percussion (35%).

Basal junction: Obtuse angled (100%).

Base: Slightly convex (100%). Chipping is crude pressure (50%), and crude percussion (50%).

Relationships

Temporal and *Spatial*: Zavala points are found in the Jornada region and are a good diagnostic of the Late Mesilla and El Paso phases–A.D. 700-1300. Again there is a question as to whether they are the same as the southern Texas type (Turner and Hester, 1985:197), but very similar ones do occur in Coahuila, Mexico (Taylor 1966). Similar points also occur in the Colorado Plateau in Puebloan times, but they seem rare or absent in the rest of the Southwest.

TYPE: HARRELL-WASHITA

Source of
Drawing: Todsen Cave, zone D

Sample

Excavation	4
Surface	8
Pictorial	10
Total	**22**

Description (based on a sample of 3)

Dimensions (in mm)

	Mean	Range
Maximum length	15.0	13.0-17.0
Maximum width	13.0	12.0-13.0
Maximum thickness	3.0	2.50-4.00
Tip to maximum body width	15.0	13.0-17.0
Body length	11.0	9.00-13.0
Body width	11.0	11.0
Notch depth R.	2.0	1.50-2.50
Notch depth L.	2.0	1.50-2.50
Stem length	7.0	5.00-8.00
Stem distal width	6.0	5.00-7.00
Stem proximal width	13.0	11.0-14.0
Base width	13.0	11.0-14.0

Form and Chipping Technique

Tip: Broken.

Body: Converging straight (100%). Dorsal and ventral surfaces show crude percussion (100%). Left edges show crude percussion (50%), and are pressure serrated (50%).

Shoulder: Acute rounded (100%).

Notch: Acute concave (100%).

Stem: Parallel straight (100%). Stem body as well as stem edges show crude percussion (100%).

Basal junction: Right angle rounded (100%).

Base: Straight (100%). Base shows crude percussion (100%).

Relationships

Temporal and *Spatial:* The Harrell-Washita type is a good time marker for Late Ceramic times and even may last into Apache times. Thus its temporal range is roughly A.D. 900-1700. Its spatial range seems to be not only in Texas (Turner and Hester 1985) but also the Southwest (Kidder 1932).

TYPE: CAMERON

Source of
Drawings: Todsen Cave, zone C

Sample

Excavation	6
Surface	4
Pictorial	10
Total	**20**

Description (based on a sample of 6)

Dimensions (in mm)

	Mean	**Range**
Maximum length	12.45	5.70(+)-16.8
Maximum width	9.73	8.20-11.3
Maximum thickness	2.85	1.90-4.20
Tip to maximum body width	12.45	5.70(+)-16.8
Body length	12.45	5.70(+)-16.8
Body width	9.73	8.20-11.3
Base width	9.08	8.20-9.50

Form and Chipping Technique

Tip: Straight acute (38%), convex acute (37%), broken (25%). Fine pressure (50%), fine percussion (25%), broken (25%).

Body: Convex converging (75%), straight converging (25%). Crude percussion (88%), and fine percussion (12%). Edges fine percussion (44%), crude percussion (6%), crude pressure (44%), and fine pressure (6%).

Basal junction: Right angle rounded (75%), and rounded eared (25%).

Base: Slightly concave (50%), straight (25%), slightly convex (25%). Crude percussion (75%), crude pressure (25%).

Relationships

Temporal and *Spatial:* The Cameron type seems to be the late variant of Fresno in the Jornada Region–A.D. 1000-1700 (Turner and Hester 1985:167). I suspect it has a similar time range over much of North America and Mexico.

Section 2

Nonhaftable Bifaces

In contrast to pointed haftable or stemmed bifaces (projectile points), the rest of the bifaces we analyzed, some 166 of which came from excavation, were a nebulous lot and did not compose well-defined types that were good time and space markers. Further, little attempt has been made in the Southwest to classify such bifaces; many are neither described nor illustrated. Thus determining their spatial significance is difficult if not impossible. We hope the following description, unsatisfactory as it may be, will serve as a foundation for a more comprehensive report in the future.

Some of the attributes we recorded were similar to those we used for projectile points; others had to be modified. We used the same orientation of the specimen: the less convex surface was called the ventral side, and the more convex was the dorsal side. The narrow end or side, like our projectile point tip, was the distal end, and the end opposite was the proximal end or base.

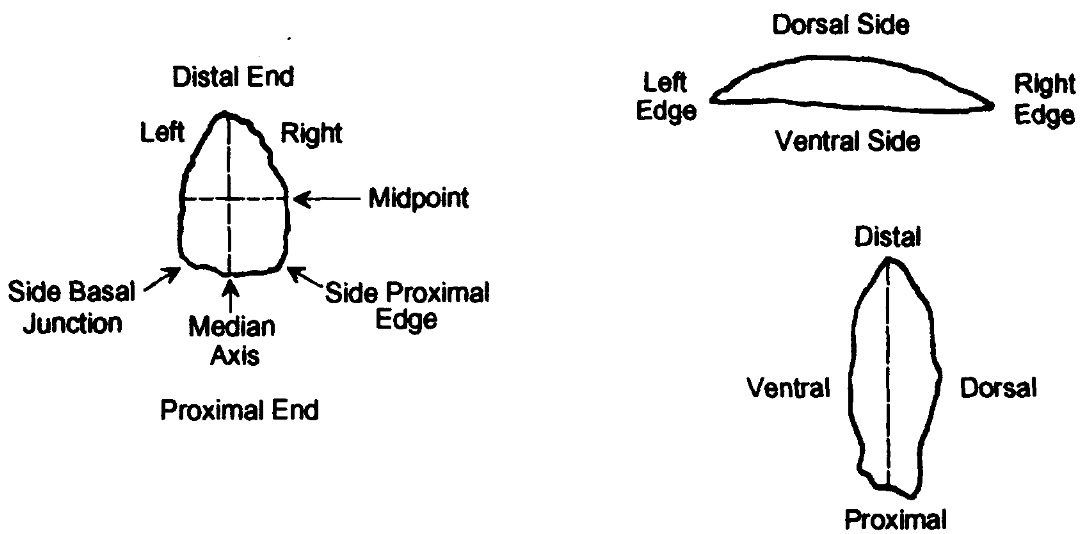


Figure IV-16. Orientation of Nonhaftable Bifaces

As with projectile points, we divided attributes into three general classes–form, dimension, and chipping technique.

Form

Most bifaces did not have shoulders, notches, or stems, just sides and basal junctions. Moreover, bifaces rarely were pointed or asymmetrical, unlike projectile points. The shapes of the distal ends for the most part differed, as shown in Figure IV-17.

Although the shapes of the body edges were vaguely similar to those of our projectile points, rarely were the two edges symmetrical or mirror images of each other, nor were they contracting or expanding towards the distal end. As a result, we usually considered the right and left edges as another set of attributes. As with our projectile points, we broke biface edges into two general categories, as shown in Figure IV-18.

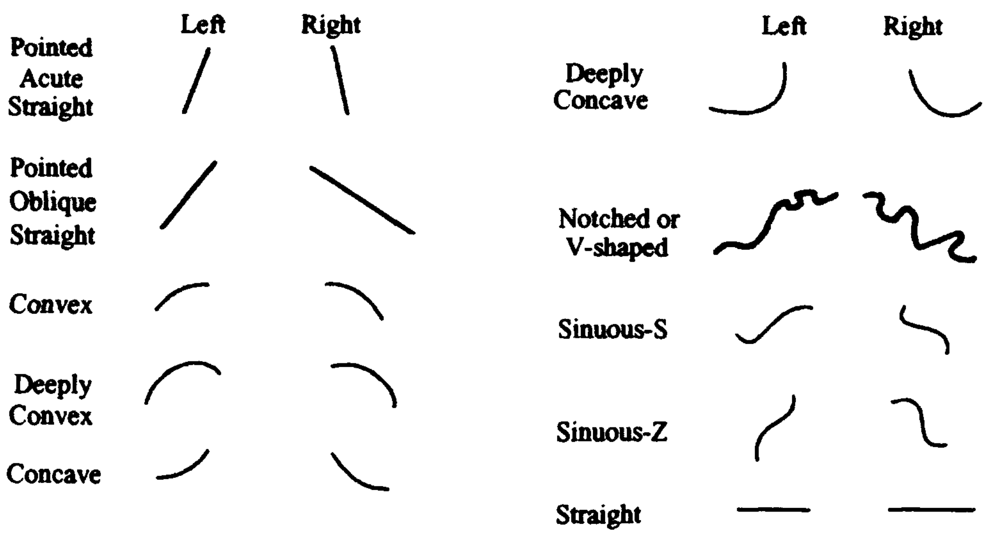


Figure IV-17. Form of Distal End of Nonhaftable Bifaces

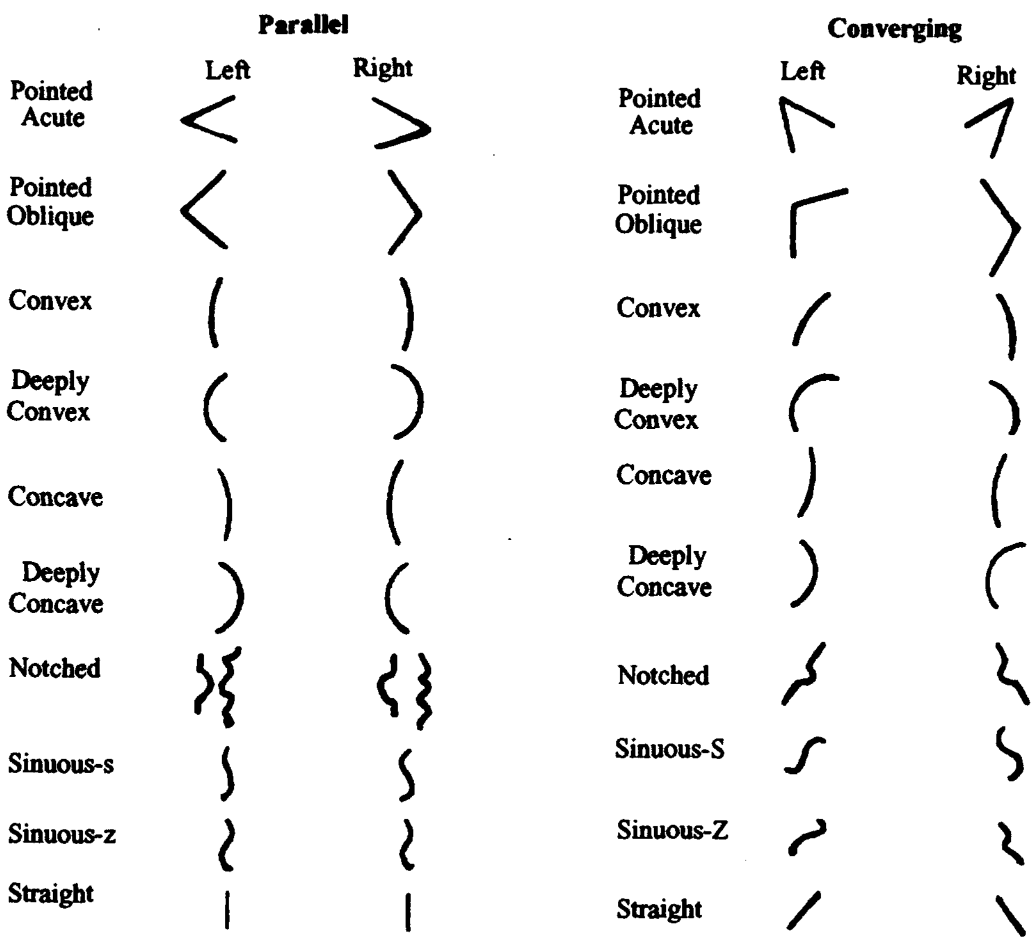


Figure IV-18. Attributes of Body Edges of Nonhaftable Bifaces

Proximal junctions were, however, just the same as with projectile points, and we probably should have recorded distal junction. We divided this class into two groups, rounded and angled, like projectile points, although the left rarely was like the right, as in projectile points.

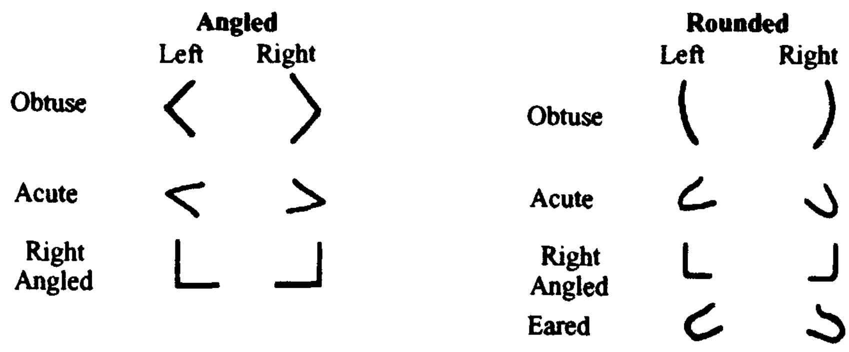


Figure IV-19. Attributes of Basal Junction of Nonhaftable Bifaces

The basal or proximal attributes, because we did not emphasize the left from the right, were exactly the same as those for projectile point types. We debated whether we should use the same set for the distal end, or use those of the projectile points. After looking at other bifacial objects, which showed relative symmetry, we decided to use the projectile point attributes.

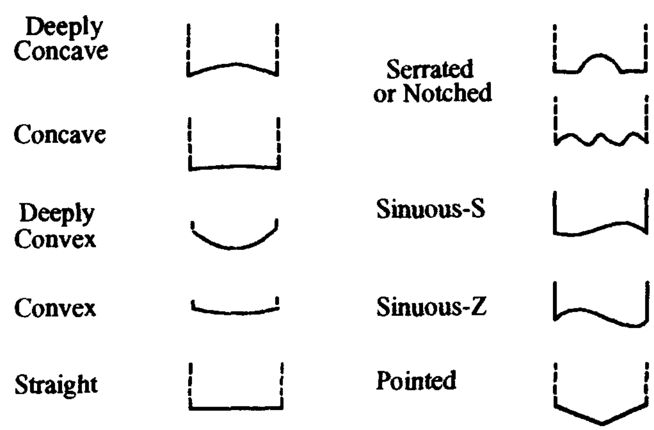


Figure IV-20. Attributes of Proximal End (Base) of Nonhaftable Bifaces

Another set of attributes–cross-section form–seemed important for these bifaces, as well as our unifaces, although these attributes were not considered important for projectile points since most, if not all, were convex-convex both in length and lateral cross section. The cross-section forms of nonhaftable bifaces appear in Figure IV-21.

In terms of cluster analysis, therefore, a large number of attributes separated the unifaces and bifaces from the projectile points.

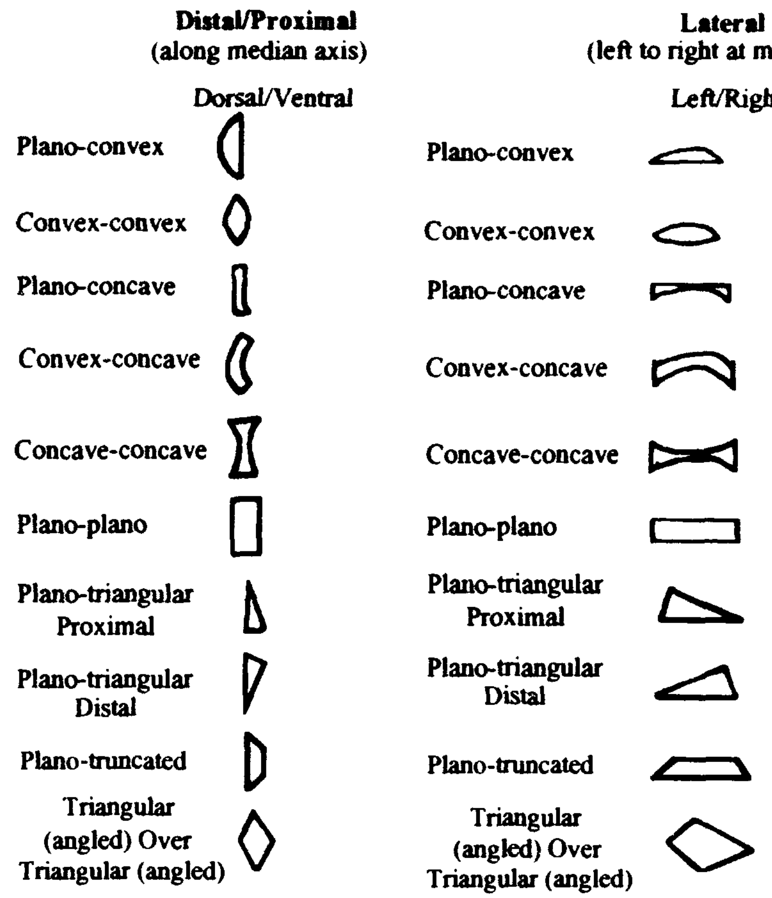


Figure IV-21. Attributes of Nonhaftable Bifaces in Cross Section

Dimension

The attributes of dimension were much like those of projectile points in that maximum length, width, and thickness were measured. Although there were no measurements for stems, notches, or shoulders, we added measurement from the distal end to the points of maximum and minimum thickness and width because these attributes were important in defining clusters for these bifaces.

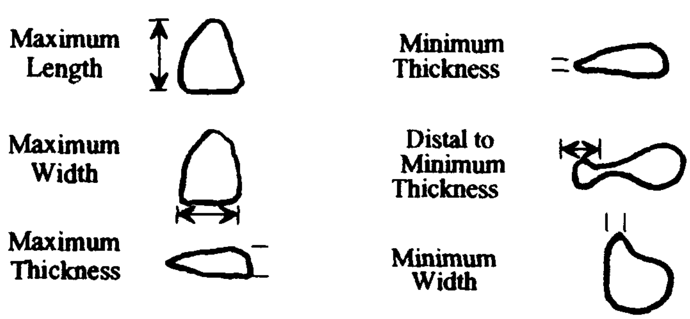


Figure IV-22. Dimensions of Nonhaftable Bifaces

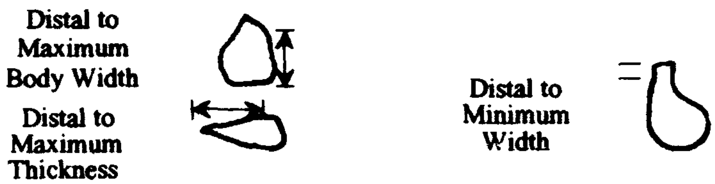


Figure IV-22. continued

Chipping Technique

The chipping techniques were similar to those used for projectile points in terms of placement–distal end or tip, proximal end or base, body surface, and body edge. Also similar were the general kinds of chipping–crude and fine percussion, crude and fine pressure, serrated pressure, fluting, and grinding. However, we also had to take into account where these kinds of chipping occurred, for unlike projectile points, the bifaces were not symmetrical in terms of either right and left sides or dorsal and ventral surfaces. These differences added many more categories and attributes to the tip or distal end, the body surface, and the edges.

DISTAL END (TIP)

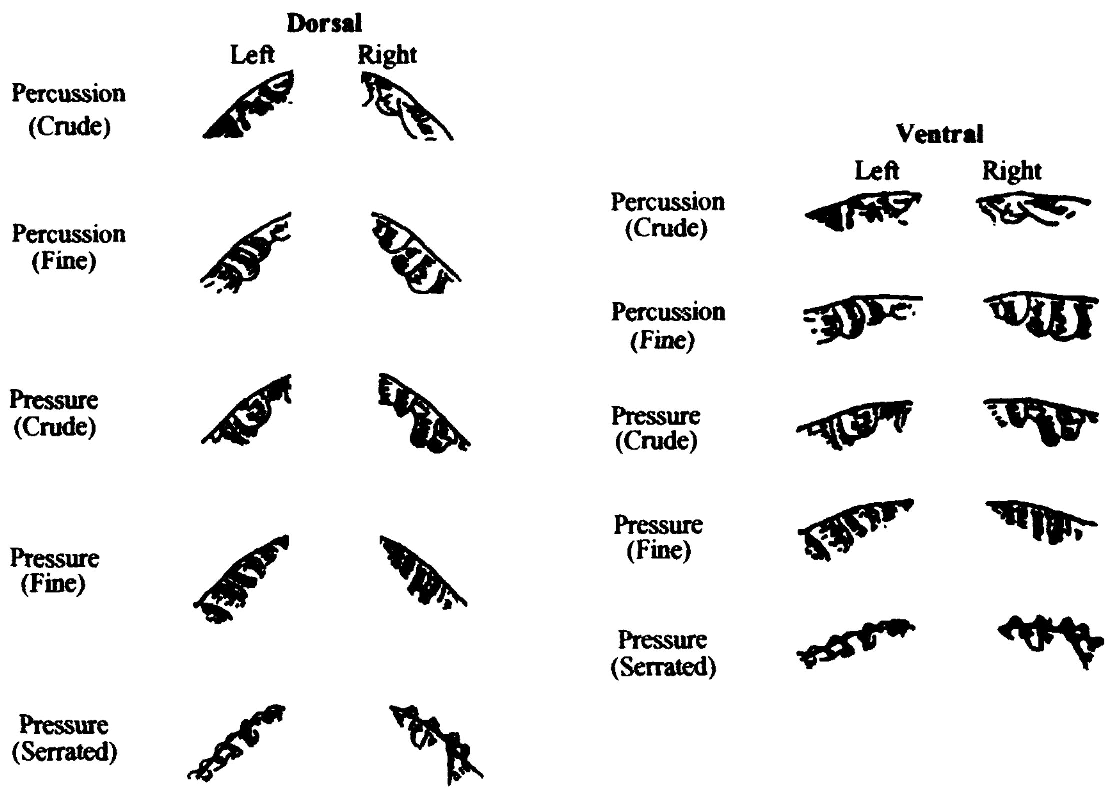


Figure IV-23. Chipping Techniques on Nonhaftable Bifaces

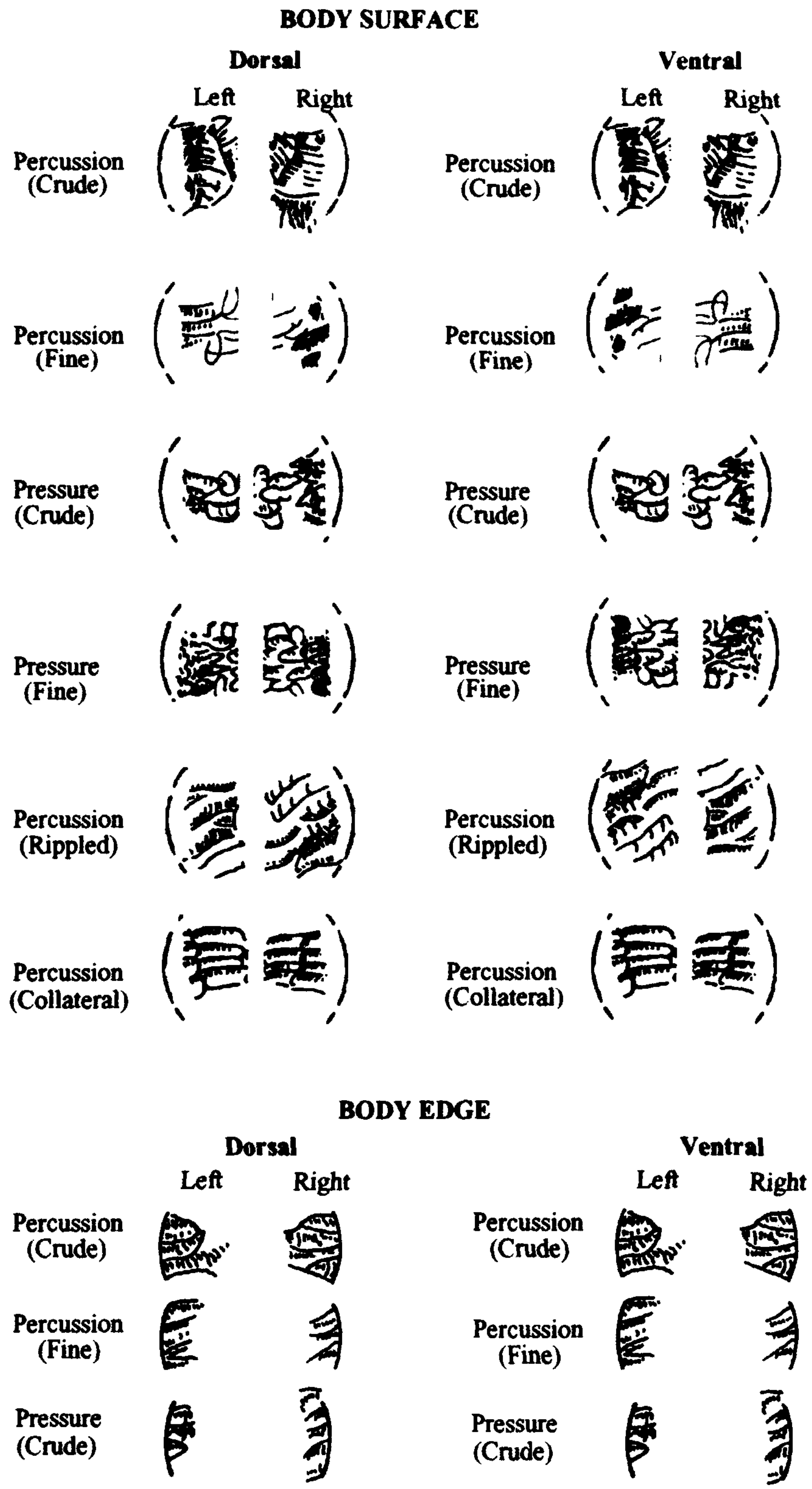


Figure IV-23. continued

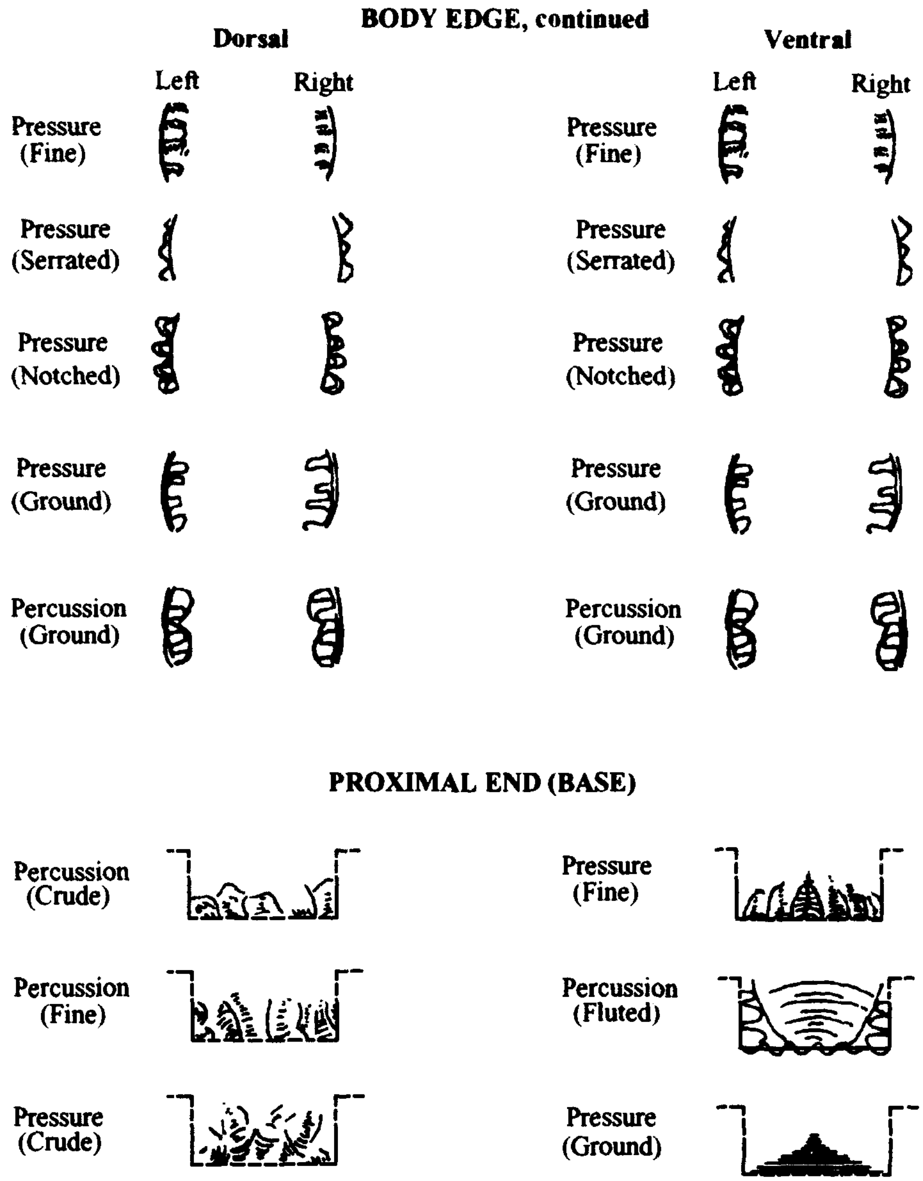


Figure IV-23. continued

Use-Wear

We also added another category -area of use-wear–which was not applicable to projectile points. Its attributes were as follows: (1) distal end, (2) proximal end, (3) distal or proximal, (4) lateral left, (5) lateral right, (6) distal end right, (7) distal end left, (8) proximal end right, (9) proximal end left, and (10) three or more edges used.

Since we had a series of attributes for the other bifaces that differed slightly from those of the projectile points, we recorded them on slightly different cards.

	dorsal		ventral	
Distal end	l ___	r ___	l ___	r ___
Body edges	___	___	___	___
Basal jnt	___	___	___	___

Base ___

Cross sections
Distal-proximal ___
Lateral-mdpt. ___

DIMENSIONS
Max. length ___
Max. width ___
Max. thick. ___
Dist. to max. body wd. ___
Dist. to max. thick ___
Min. thick. ___
Dist. to min. thick. ___
Min. width ___ ___
Dist. to min. width ___

CHIPPING TECHNIQUE

	dorsal		ventral	
Distal end	l ___	r ___	l ___	r ___
Body edge	l ___	r ___	l ___	r ___
Proximal end	___		___	
Area of use-wear	___		___	

Site
Square
Level
Zone
Catalogue

TYPE
Date of Recording

Figure IV-24. Cards for Recording Attributes of Nonhaftable Bifaces

We recorded our other bifaces on this type of card and then compared the data on the cards to determine what cluster we had. As might be expected, the bifaces fell into two large groups–those that had mainly or totally percussion flaking, and those that had mainly pressure or finer percussion chipping. The cruder bifaces fell into two groups. One group had pebble cortex and could be subdivided further into thin pebble bifaces (pebble cleavers) and pebble choppers. A second group of crude bifaces had three subtypes–flake choppers, battered hammerstones, and nebulous cores.

The finely chipped bifaces also could be subdivided. One group with the discoidal shape divided further into large and small types. The other group, knife blades, could be subdivided into end knife blades and half-moon side knife blades, as shown in Figure IV-25.

Determining the spatial significance of the types was hampered by the fact that these types of artifacts rarely are adequately described or illustrated in reports on the Southwest, Texas, and Coahuila in Mexico. However, our stratigraphic excavation of Todsen Cave hints that they do have temporal significance–albeit of a very uneven nature. For example, nebulous cores were significant only in that they occurred in all levels at all time periods . On the early level, pebble cleavers seem important only in Early Archaic times, although some lasted into later times. This is also true for our half-moon side blades; the two later ones we found in ceramic levels could well have been exhumed from early

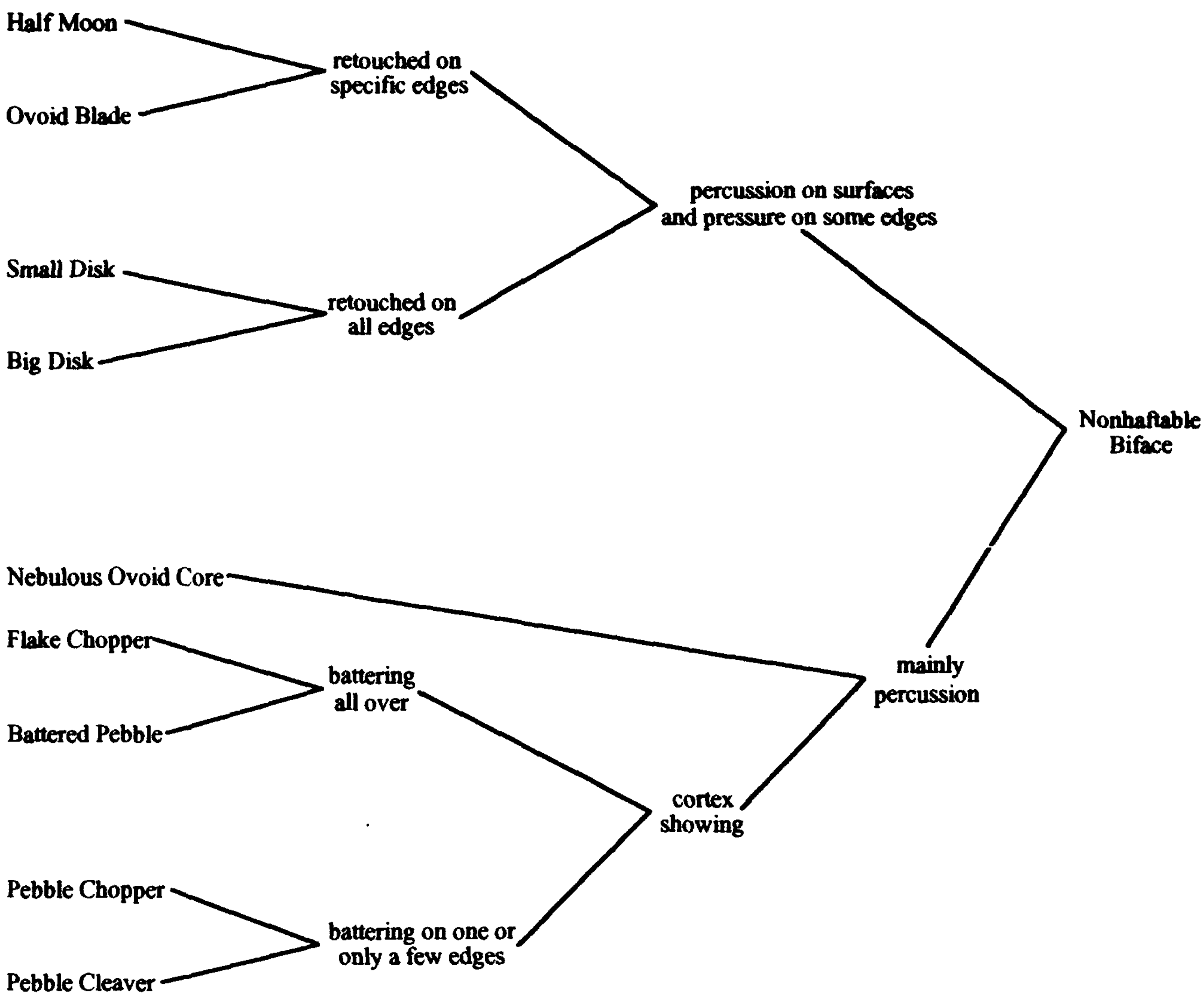


Figure IV-25. Cluster Analysis of Nonhaftable Biface Types

levels. Surface collections seem to indicate some also occur in Paleo-Indian levels. Pebble choppers perhaps are the most characteristic type of the Archaic, but they may last into Mesilla times. Large ovoid disks show a similar distribution. Battered hammerstones and flake choppers seem to be mainly of Late Archaic times, while ovoid knives, as well as small, chipped disks, start in the Archaic but become popular during ceramic times.

Thus we have hints that our generalized bifaces are time markers, perhaps not so sensitive as projectile points, but just as numerous.

Table IV-4. Correlation of Nonhaftable Biface Types with Components in the Jornada Region

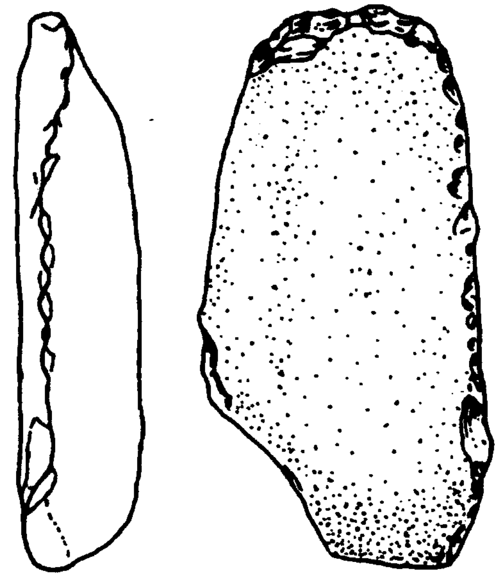
	Pebble Cleaver	Pebble Chopper	Half-moon Side Blade	Large Ovoid Biface	Nebulous Core	Bifacial knife (blank)	Battered Spheroid Hammer	Flake Chopper	Small Bifacial Disk	TOTAL	PHASE
TOTAL	27	32	7	22	49	24	4	7	26	208	
LA5529, surface		1			3	3		2	2		EL PASO/DOÑA ANA
LA5531, surface		2		2	3	1		2	3		
LA5531, Zone C					1				1		
LA5531, Zone D					3	1			2		
Rincon, level 3									1		
LA5531, Zone D1					1	1					
LA5531, Zone F+	3	2	1	2	4	2			3		MESILLA
LA5529, Zone A-B	2				3				1		
Sonrisa, level 1		1				2					
Roller Skate, level 3						1			1		
LA5531, Zone D2		1	1	1	1						
LA5531, Zone E									1		HUECO
LA5531, Feature 7									1		
LA5531, Zone upper B	1	1			4	4	1		4		
LA5531, Zone E1					1						
LA5531, Zone πJ	2	3		2	7	1	1	1	3		
LA5531, Zone E2					1						
LA5531, Zone F		1					1				FRESNAL
LA5531, Zone J		3		3	2	2		1	1		
Tornillo, Zone C					1						
LA5529, Zone middle B	1	1		3	2	1			1		
LA5529, Feature 2											
LA5531, Zone J1	2	1		2	2	3	1	1			
LA5529, Feature 13				1							KEY-STONE
LA5529, Zone K	3	3	1	2	3	2					
LA5529, Feature 8									1		GARDNER SPRINGS
LA5529, Zone upper C				1	2						
LA5529, Feature 1			1		1						
LA5531, Zone K1	2	2	2	3							
LA5531, Zone M-N	6	9			1						
LA5529, Zone lower C	4	1									
LA5529, Zone E	1?										

TYPE: PEBBLE CLEAVER

Source of Drawings: Todsen Cave, zone N

Sample

Excavation	27
Surface	5
Pictorial	2
Total	**34**

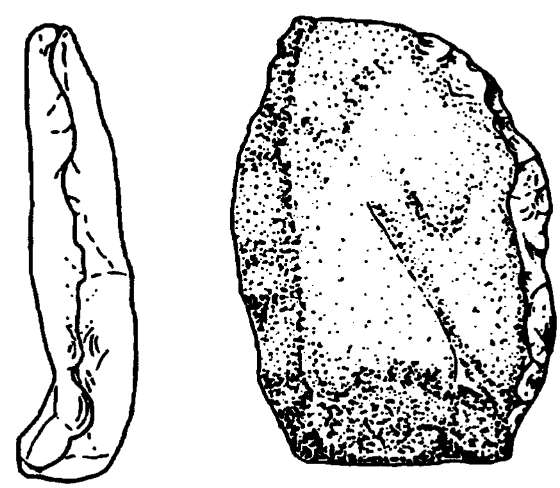


(drawings = ½ natural size)

Description (based on a sample of 6)

Dimensions (in mm)

	Mean	Range
Maximum length	110.75	98.0-132.0
Maximum width	67.50	50.0-83.0
Maximum thickness	29.50	21.0-38.0
Distal to maximum body width	67.75	47.0-92.0
Distal to maximum thickness	87.50	63.0-102.0
Minimum thickness	11.25	9.00-18.0
Distal to minimum thickness	64.75	17.0-130.0
Minimum width	35.50	24.0-50.0
Distal to minimum width	88.50	15.0-132.0



Form and Chipping Technique

Distal (Tip) End: Form on the right side is convex (50%), pointed straight acute (33%), or pointed straight oblique (17%). Form on the left side also is mainly convex (50%), with some cleavers being pointed straight acute or straight.

Chipping, both dorsal right and left, mainly is crude. Chipping on the ventral right (when it occurs) is the same as ventral left. Many cleavers (about 30%) have no chipping on the distal end so the cortex of the flat pebble still is present.

Body Edge: Form always is converging (100%) right edge, mainly convex (80%) or straight (20%). Left edge, pointed oblique (33%), convex (33%), converging straight, or deeply convex.

Chipping on dorsal right and left and on ventral right always is crude percussion. Ventral left is the same except for a cleaver used for chopping on this edge that had fine percussion to provide a better cutting or scraping edge.

Body Surface: Form in cross section from distal to proximal mainly is triangular with a distal emphasis, while the cross section left to right either is truncated (50%), prismatic (25%), or convex-convex (25%).

Chipping on both dorsal and ventral surfaces is crude percussion, and often the cortex of the original flat pebble is present.

Basal junction: Form on the right either is obtuse angled (50%), or round (50%). On the left it mainly is obtuse angled (70%), although a few are rounded acute and right angled (30%).

Proximal (Base) End: Form usually is straight (50%), but some are convex (33%), or deeply convex (16%). Often the reason for the edge being straight is that this was the cutting or scraping edge.

Chipping usually is crude percussion on both the dorsal and ventral surfaces; a few cleavers have fine percussion

on both surfaces to aid in making a cutting edge.

Area Of Use-Wear: Usually the broad proximal end, but the lateral edge also may be used.

Relationships

Temporal. Pebble cleavers mainly are an Early Archaic type that occur occasionally in later horizons in the Jornada region. They do not seem to occur in Paleo-Indian times. Thus their life span commences about 7000-6000 B.C. and might last into ceramic times.

Spatial. In the Cochise sequence, some cleavers, called sinuous edge, may occur in the Sulphur Springs horizon at 7300-6000 B.C. (Waters 1986, figure 4.5). They seem rare or absent in the later Chiricahua or San Pedro phases (Dick 1965, figure 25). Some also may occur even in the volcanic zone of Ventana Cave during about the same time period (Haury 1950). Whether these pebble cleavers occur in the Oshara tradition of the Colorado Plateau is more difficult to determine, but a few from the Bajada phase seem similar.

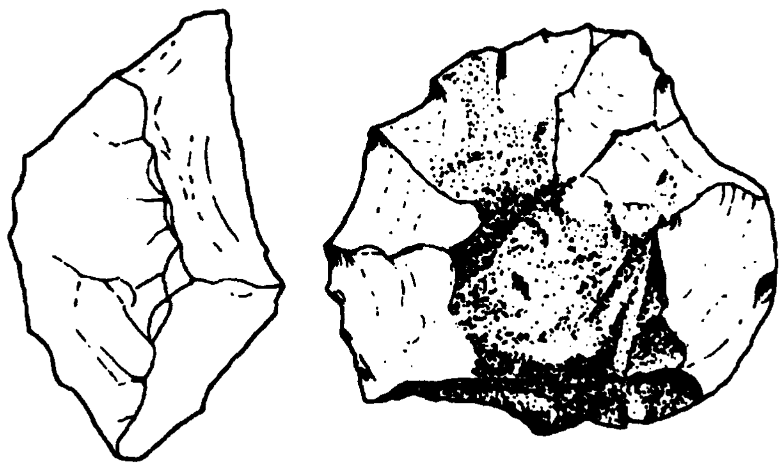
TYPE: PEBBLE CHOPPER

Sources of Drawings: Todsen Cave: top, zone J; bottom, zone πJ

Sample

Excavation	30
Surface	2
Pictorial	5
Total	**37**

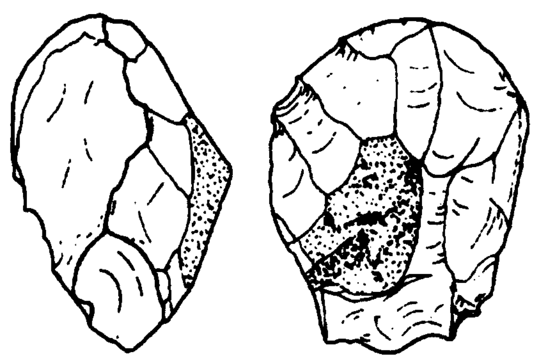
(drawings = ½ natural size)



Description (based on a sample of 8)

Dimensions (in mm)

	Mean	Range
Maximum length	108.25	74.0-143.0
Maximum width	59.00	73.0-111.0
Maximum thickness	45.00	39.0-52.0
Distal to maximum body width	54.50	33.0-72.0
Distal to maximum thickness	66.25	43.0-87.0
Minimum thickness	16.50	10.0-26.0
Distal to minimum thickness	56.50	4.00-137.0
Minimum width	26.25	13.0-37.0
Distal to minimum width	53.50	0-110.0



Form and Chipping Technique

Distal (Tip) End: Form on the right end mainly is convex (80%,) as is the left part of the end, but a few are oblique points (10%), and one is even concave (10%).

Chipping does not occur on the body surface that bears the cortex of the ovoid pebble, but the dorsal right margin

has crude percussion; the dorsal left mainly has crude percussion as does ventral right, but ventral left has both crude and fine percussion on two choppers where this part was used for chopping.

Body Edge: Form reflects the form of the ovoid pebble so the right and left edges are deeply convex (100%).

Chipping occurs on only about half of the edges; only 33% of the dorsal right has crude percussion, although the dorsal left has such on all specimens as does the ventral right, but the ventral left has both crude percussion (33%) and fine pressure (33%) or percussion for chopping.

Body Surface: Form of cross section distal to proximal mainly is convex-convex (60%), or deeply convex-convex (40%), while cross section, left to right, shows the choppers not only to be convex-convex (60%), but also truncated (20%), and trianguloid (20%).

Chipping only occurs on about 50% of the body surface, but 55% of the dorsal surface has crude percussion as does the ventral surface.

Basal junction: Since these choppers are ovoid or ellipsoidal pebbles, they are angled on the right (50%) as well as left obtuse rounded (50%).

Proximal Base: Form usually is deeply convex (100%). Chipping occurs on only about 40% of both dorsal and ventral and mainly is percussion, except one that has crude pressure to make a sharp edge.

Area of Use-Wear: Usually on more than one edge, with laterals most common, but distal and proximal edges also are used.

Relationships

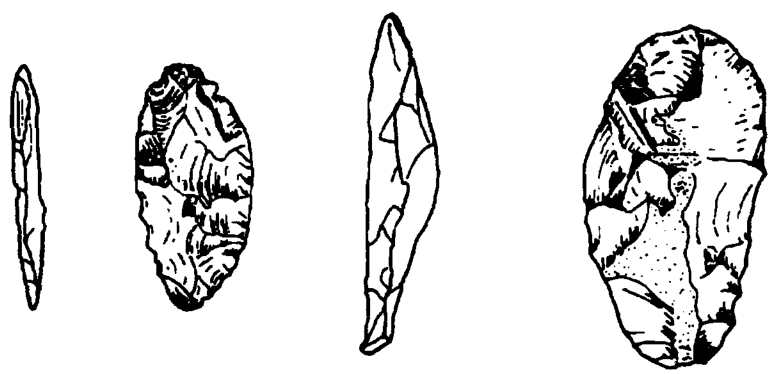
Temporal and *Spatial*: Pebble choppers characterize the Archaic and last into the Mesilla phase in the Jornada region (6000 B.C.-A.D. 1000). They also are typical of the Cochise horizons from Sulphur Springs to San Pedro (Sayles 1983) and last into early Hohokam and Mogollon horizons. In the Oshara tradition they seem to occur most frequently in the Bajada period, but certainly last into San Jose times (Irwin-Williams 1973). To the east in Texas and the Big Bend (Shafer 1986) they seem less frequent; when they do occur, they most often appear in the Early Archaic rather than later times.

TYPE: HALF-MOON SIDE BLADE

Sources of Drawings: Todsen Cave: left, zone D2; right, zone Kl

Sample

Excavation	7
Surface	1
Pictorial	2
Total	**10**



(drawings = ½ natural size)

Description (based on a sample of 4)

Dimensions (in mm)

	Mean	Range
Maximum length	67.00	46.0-90.0
Maximum width	33.50	27.0-40.0
Maximum thickness	12.25	7.00-17.0
Distal to maximum body width	46.25	33.0-73.0
Distal to maximum thickness	31.00	9.00-44.0

	Mean	Range
Minimum thickness	4.00	3.00-5.00
Distal to minimum thickness	29.75	4.00-84.0
Minimum width	13.50	11.0-20.0
Distal to minimum width	5.75	4.00-9.00

Form and Chipping Technique

Distal (Tip) End: Form on the right usually is convex (60%), and/or pointed oblique acute (20%), while the left often is only convex (20%).

Chipping on the dorsal right and dorsal left mainly is crude percussion (80%), but a few side blades have fine percussion (20%) and crude pressure to give them a point. The ventral right and left are the same.

Body Edge: One edge, often the right (100%), is more convex–often deeply convex–while the opposite edge is slightly convex (50%) to straight (50%), giving a half-moon appearance.

Chipping on all edges often is fine pressure. The more convex edge often is used and better chipped. Form in cross section distal to proximal as well as cross section, left to right, usually is plano-convex (75%), while only one was convex-convex (25%).

Chipping on both the dorsal and ventral surfaces is crude percussion.

Basal junction: Form on the right and left usually is oblique rounded (80%), but a few are right angle rounded (20%).

Proximal Base: Form usually is deeply convex (50%), but one is straight (25%), and another slightly convex (25%).

Chipping on the dorsal and ventral surface is crude percussion.

Area of Use-Wear: Lateral edge or edges.

Relationships

Temporal: Our excavations in the Jornada region seem to show these half-moon side blades are mainly an Early Archaic type, while surface collection hints they might occur on Paleo-Indian levels. Thus the time period might be roughly 8000-4000 B.C.

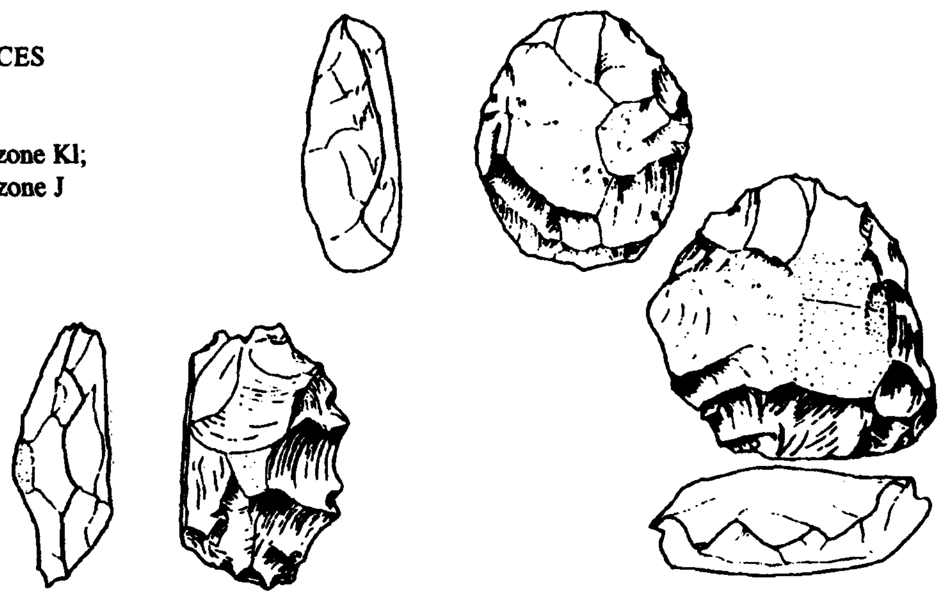
Spatial: As far as we could determine (from inadequate descriptions), half-moon side blades seem absent in the Cochise regions of the Mogollon Rim (Dick 1965, figure 15) and the Colorado Plateau (Irwin-Williams 1973, figure 3m).

TYPE: LARGE OVOID BIFACES

Sources of Drawings: Todsen Cave: top, zone Kl; left, zone Jl; right, zone J

Sample

Excavation	21
Surface	2
Pictorial	2
Total	**25**



(drawings = ½ natural size)

Description (based on a sample of 6)

Dimensions (in mm)

	Mean	Range
Maximum length	67.2	65.0-70.0
Maximum width	55.2	41.0-72.0
Maximum thickness	26.8	23.0-31.0
Distal to maximum body width	44.0	30.0-53.0
Distal to maximum thickness	34.6	31.0-39.0
Minimum thickness	11.0	9.00-13.0
Distal to minimum thickness	16.0	6.00-29.0
Minimum width	33.6	14.0-46.0
Distal to minimum width	11.6	6.00-29.0

Form and Chipping Technique

Large ovoid or round bifaces are convex-convex in their relatively thin cross section and have percussion on all their surfaces and edges. Certainly some are quarry blanks, but about 33% have one or more edges or ends with finer percussion or pressure retouch and/or battering, indicating they also were used as hammers, choppers, cleavers, or knives.

Relationships

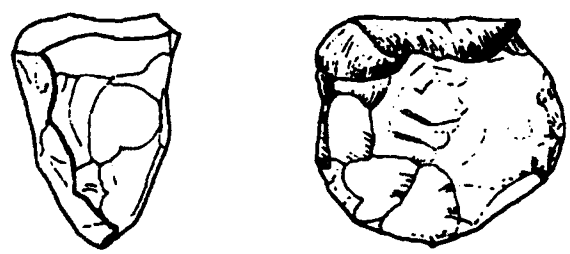
Temporal and *Spatial:* Large ovoid bifaces are fairly typical of the time from the Archaic to the Mesilla horizon in the Jornada region, being perhaps slightly more popular in later times than the early horizons, but the difference is not marked. Some of the straight-edge core tools of the Chiricahua (Sayles 1983, figure 9.4nu) and San Pedro (Dick 1965, figure 27) and early ceramic horizons to the west may be related (Haury 1950, figure 44); if so, they have a similar temporal span. In the Oshara tradition, the bifaces of the San Jose horizon seem most similar (Irwin-Williams 1973, figure 5n). Determining their distribution eastward from the Jornada region is difficult because of the lack of distributional studies.

TYPE: NEBULOUS CORE

Source of Drawings: North Mesa, surface

Sample

Excavation	49
Surface	5
Pictorial	5
Total	**59**



(drawings = ½ natural size)

Description (based on a sample of 10)

Dimensions (in mm)

	Mean	Range
Maximum length	42.0	28.0-161.0
Maximum width	41.0	20.0-80.0
Maximum thickness	19.0	10.0-70.0

Form and Chipping Technique

These cores come in all shapes and sizes, but generally speaking are cuboid to conical. Often they were made from pebbles that were split; the new surface then was used as a striking platform for removing cortex and flakes from the adjacent sides. However, other cores seem initially to have been slabs or cubes of flint used in a similar manner. Most nebulous cores usually have one surface with a prepared striking platform (60%), but some have two surfaces (20%), and others more.

Relationships

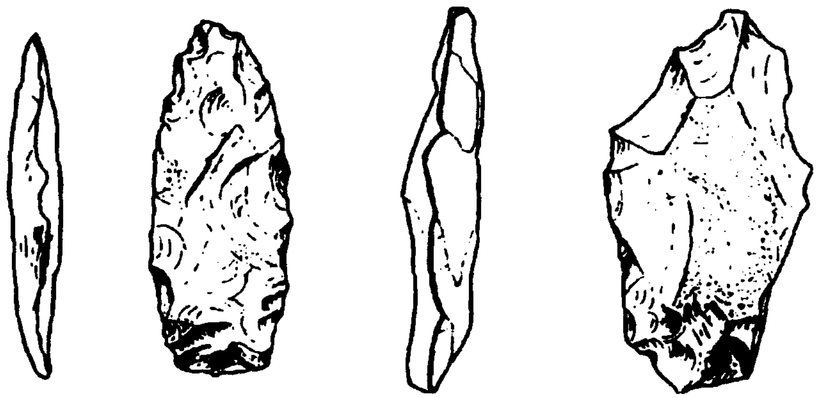
Temporal and *Spatial:* Nebulous cores are a generalized type occurring at all times in all places.

TYPE: BIFACIAL KNIFE

Source of
Drawings: Todsen Cave, zone J1

Sample

Excavation	21
Surface	2
Pictorial	2
Total	**25**



(drawings = ½ natural size)

Description (based on a sample of 4)

Dimensions (in mm)

	Mean	**Range**
Maximum length	81.5	77.0-86.0
Maximum width	37.5	31.0-44.0
Maximum thickness	14.5	11.0-18.0
Distal to maximum body width	39.5	36.0-43.0
Distal to maximum thickness	51.0	50.0-52.0
Minimum thickness	8.5	6.00-11.0
Distal to minimum thickness	59.5	51.0-68.0
Minimum width	7.0	6.00-8.00
Distal to minimum width	3.0	0.30-3.00

Form and Chipping Technique

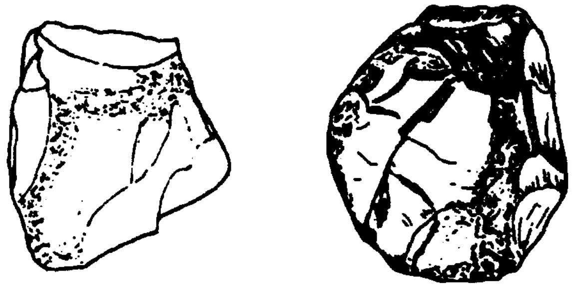
Bifacial knives are relatively thin, with one end more or less pointed (80%), and the proximal end more squarish (80%). Often the sides and point are retouched more finely, indicating use as cutting knives or as piercing tools. The variety of workmanship and shapes is wide. These knives blend into the thinner, large ovoid biface and Nogales point.

Relationships

Temporal and *Spatial:* Although these knives occur starting in Middle Archaic times and last into ceramic times, they are an extremely generalized type with a wide temporal and spatial distribution.

TYPE: BATTERED HAMMERSTONE

Source of
Drawings: Todsen Cave, zone F+



(*drawings = ½ natural size)*

Sample

Excavation	4
Surface	2
Pictorial	4
Total	**10**

Description (based on a sample of 2)

Dimensions (in mm)

	Mean	Range
Maximum length	94.0	68.0-120.0
Maximum width	77.5	58.0-97.0
Maximum thickness	63.0	58.0-68.0
Distal to maximum body width	55.0	45.0-65.0
Distal to maximum thickness	47.5	31.0-64.0
Minimum thickness	35.5	26.0-45.0
Distal to minimum thickness	49.5	0-99.0
Minimum width	35.0	20.0-50.0
Distal to minimum width	59.0	12.0-106.0

Form and Chipping Technique

Battered hammerstones, like pebble choppers, are made from pebbles, from which all the cortex has been removed, and one or both ends of these ellipsoidal chipped objects was battered when it was used as a hammer.

Relationships

Temporal and *Spatial:* Battered hammerstones mainly are a Middle and Late Archaic type (4000-0 B.C.) in the Jornada region. In both the Gila and Mogollon Rim area of Cochise they seem to have a similar distribution, being popular in both Chiricahua and San Pedro times (Sayles 1983, figure 9.4; Waters 1986, figure 4.5a). When they appear in the Oshara tradition (Irwin-Williams 1973, figure 3n) and Texas could not be determined.

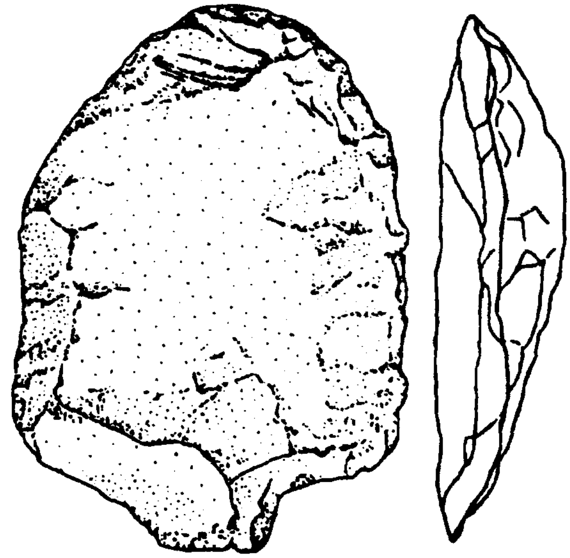
TYPE: FLAKE CHOPPER

Source of
Drawings: Cueva Pintada,
Oro Grande, zone A (see next page)

Sample

Excavation	3
Surface	2
Pictorial	2
Total	**7**

FLAKE CHOPPER



(drawings = ½ natural size)

Description (based on a sample of 3)
Dimensions (in mm)

	Mean	**Range**
Maximum length	88.0	71.0-118.0
Maximum width	64.0	54.0-92.0
Maximum thickness	18.0	8.00-41.0
Distal to maximum body width	60.0	42.0-78.0
Distal to maximum thickness	72.0	55.0-91.0
Minimum thickness	5.0	4.00-12.0
Distal to minimum thickness	66.0	32.0-71.0
Minimum width	28.0	14.0-41.0
Distal to minimum width	12.0	8.00-21.0

Form and Chipping Technique

Generally flake choppers are long slabs or flakes that often are rectanguloid (60%) to ovoid (40%) in outline, and are plano-trianguloid with a distal emphasis in cross section longitudinally and plano-plano laterally.

One end, often the distal, is a striking platform. This end is more or less straight (50%), or slightly convex (50%), while the long, often converging sides are straight (60%) to convex (40%) with a few percussion blows. In most cases (75%) they have been retouched or battered, with most use-wear on the straight or convex proximal end.

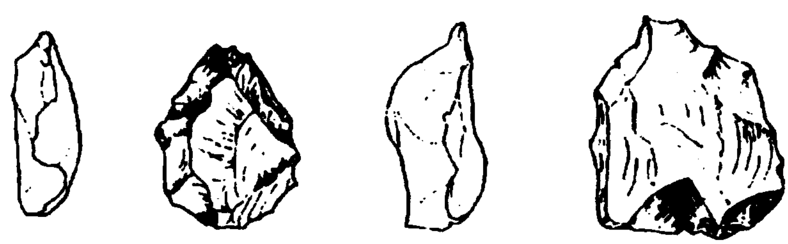
Usually only one to three scars is on either surface of the flake.

Relationships

In the Jornada region flake choppers mainly are of Fresnal and Hueco times (2500 B.C.-A.D. 300). They may be related to some of the straight-edge Cochise choppers that have a similar time span in Chiricahua (Haury 1950, figure 31) and San Pedro (Dick 1965, figure 28) times. When they occur in Oshara and Texas is difficult to determine.

TYPE: SMALL BIFACIAL DISKS

Sources of
Drawings: Todsen Cave: left, zone F+, right, zone πJ



(drawings = ½ natural size)

Sample

Excavation	23
Surface	2
Pictorial	10
Total	**35**

Description (based on a sample of 6)
Dimensions (in mm)

	Mean	**Range**
Maximum length	51.33	39.0-61.0
Maximum width	44.16	33.0-52.0
Maximum thickness	25.66	20.0-34.0
Distal to maximum body width	39.50	28.0-48.0

	Mean	Range
Distal to maximum thickness	33.66	22.0-48.0
Minimum thickness	8.83	7.00-11.0
Distal to minimum thickness	23.66	4.00-55.0
Minimum width	21.83	10.0-30.0
Distal to minimum width	30.83	1.00-60.0

Form and Chipping Technique

These bifaces are relatively small ovoids or disks, usually convex-convex or deeply convex-convex in cross section. Telling dorsal from ventral and proximal from distal often is difficult since most chipping is crude percussion. Some disks could be used-up cores or small quarry blanks, but some (30%) bear finer chipping or battering on one or more edges, and some (10%) have such workmanship on all edges, suggesting they were choppers or hammers.

Relationships

Temporal and *Spatial:* In the Jornada region small bifacial disks may begin in the Fresnal horizon as early as 2000 B.C., but they are most popular in Hueco times and last into ceramic times. In the Cochise region they occur mainly in the San Pedro period (Dick 1965, figure 34; Haury 1950, figures 28 and 32), roughly contemporaneous with those in the Jornada region. We could not determine their distribution in the Colorado Plateau (Morris and Burgh 1954, figure 88, nos. 1 and 2) or Texas areas.

Section 3

Terminally Worked Unifaces

We uncovered about 325 terminally worked unifaces (also known as end scrapers) from excavation in the Jornada region–mainly from Todsen Cave and the North Mesa site, and a few from the Organ Mountain shelters. Unfortunately, we were unable to analyze these types from the La Cueva or Fresnal collections. In the Tularosa Basin survey on Fort Bliss no terminally worked unifaces were even brought in from the field, and no attempts had been made to classify this group of tools at any of these sites. Outside the Jornada region, few attempts have been made to classify end scrapers into types (Haury's 1950 Ventana Cave report excepted), even though such tools often were illustrated. Site reports from Utah (Danger Cave), California, Texas, and northern Mexico (MacNeish 1958) were somewhat better, but the use of different attributes made it difficult to compare types from those regions with ours. In terms of our local sequence, however, particularly during Archaic times, end scrapers were quite good time markers.

The classes of attributes we utilized for classifying the end scrapers were roughly the same as those used for other bifaces and for laterally worked unifaces (see Section 4), although some of the specific attributes differed slightly. These included all those attributes having to do with ventral chipping on distal and proximal ends, as well as edges, since our end scrapers were unifacial with mainly (or only) dorsal chipping. In spite of these differences, the terminology and the orientation of the specimens were the same (see Figure IV-16).

The attributes of form for the distal end are the same as for bifaces. Also the same are the body edge attributes (see figures IV-17, IV-18). Unlike the body edge attributes of projectile points, however, end scrapers have no attributes contracting or expanding to the tip.

Basal junction attributes for all groups are, of course, the same, although terminally worked unifaces lack the shoulder, notch, and stem attributes found in projectile points (see Figure IV-19).

Attributes of the proximal end, or base, also are the same, although very few notched, sinuous, or pointed bases occur (see Figure IV-20).

The cross-section attributes also are almost the same for all groups; although convex-convex almost never occurs in unifacial, convex to slightly convex do. Further, trianguloid unifaces with distal or proximal emphasis become very important.

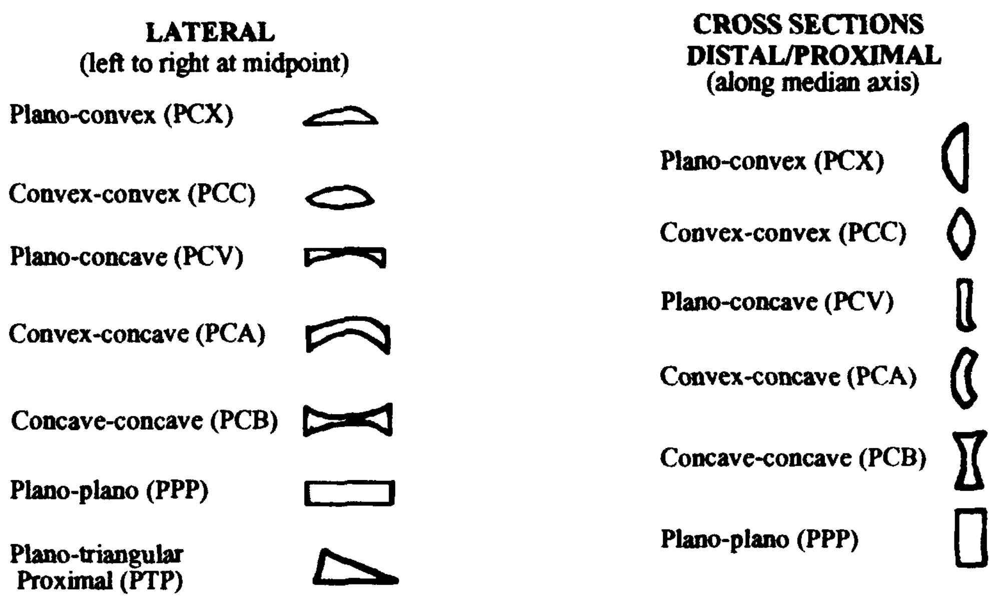


Figure IV-26. Attributes of Terminally Worked Unifaces in Cross Section

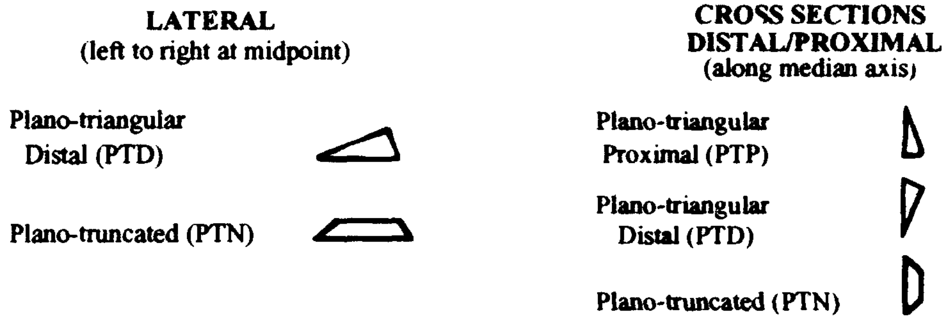


Figure IV-26. *continued*

Dimensional attributes for the unifaces and other bifaces are the same; they differ from projectile points in lacking stems and notch attributes and in having attributes concerning minimum thickness.

The chipping technique attributes for unifaces were different from bifaces in that those concerning ventral surface did not occur.

The attributes of each terminally worked uniface were, like the attributes for unhaftable bifaces, recorded on 3"x5" cards (see Figure IV-24).

When we compared the cards with one another, they fell in quite definite clusters. On the highest level, the large, more or less plano-convex crude chipped group (or scraper planes) was separate from the small to medium unifaces with fine, steep retouching on their distal or proximal ends (our end scrapers). The scraper planes then broke into two clusters: one group, which comprised denticulate and pebble scraper planes, had unifaces that always were large and plano-convex with definite deeply convex distal and proximal ends, steep chipping on the proximal ends and crude chipping on the surface, often with the cortex showing. The other group of scraper planes, flake and dome types, often had flat percussion-flaked tops and pointed to straight bases and distal ends; they also had retouch not only on their

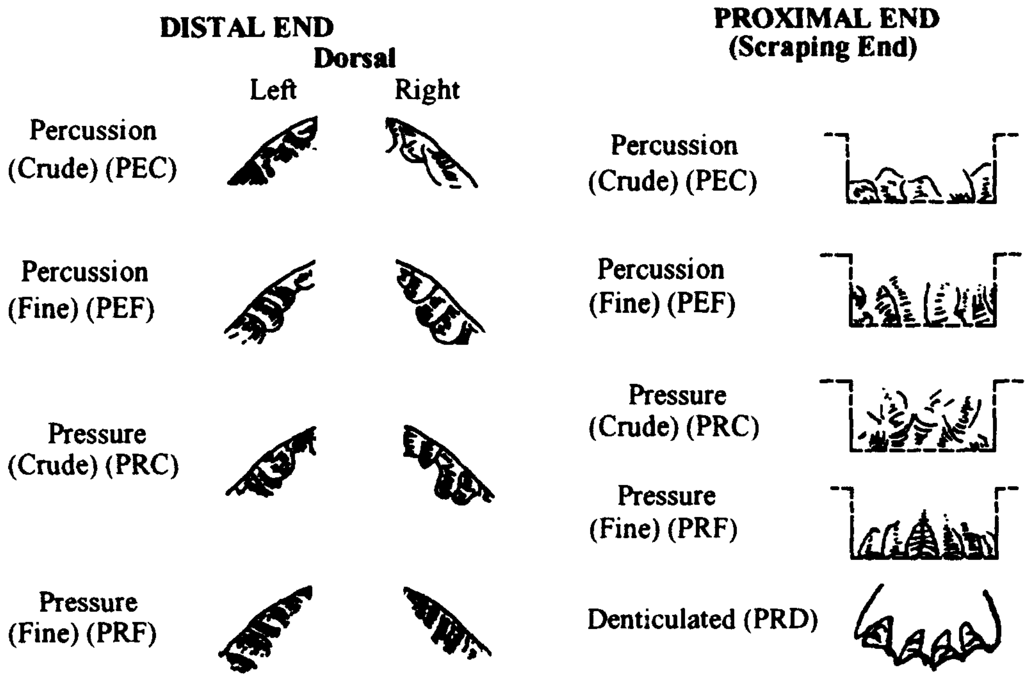


Figure IV-27. Chipping Technique Attributes on Terminally Worked Unifaces

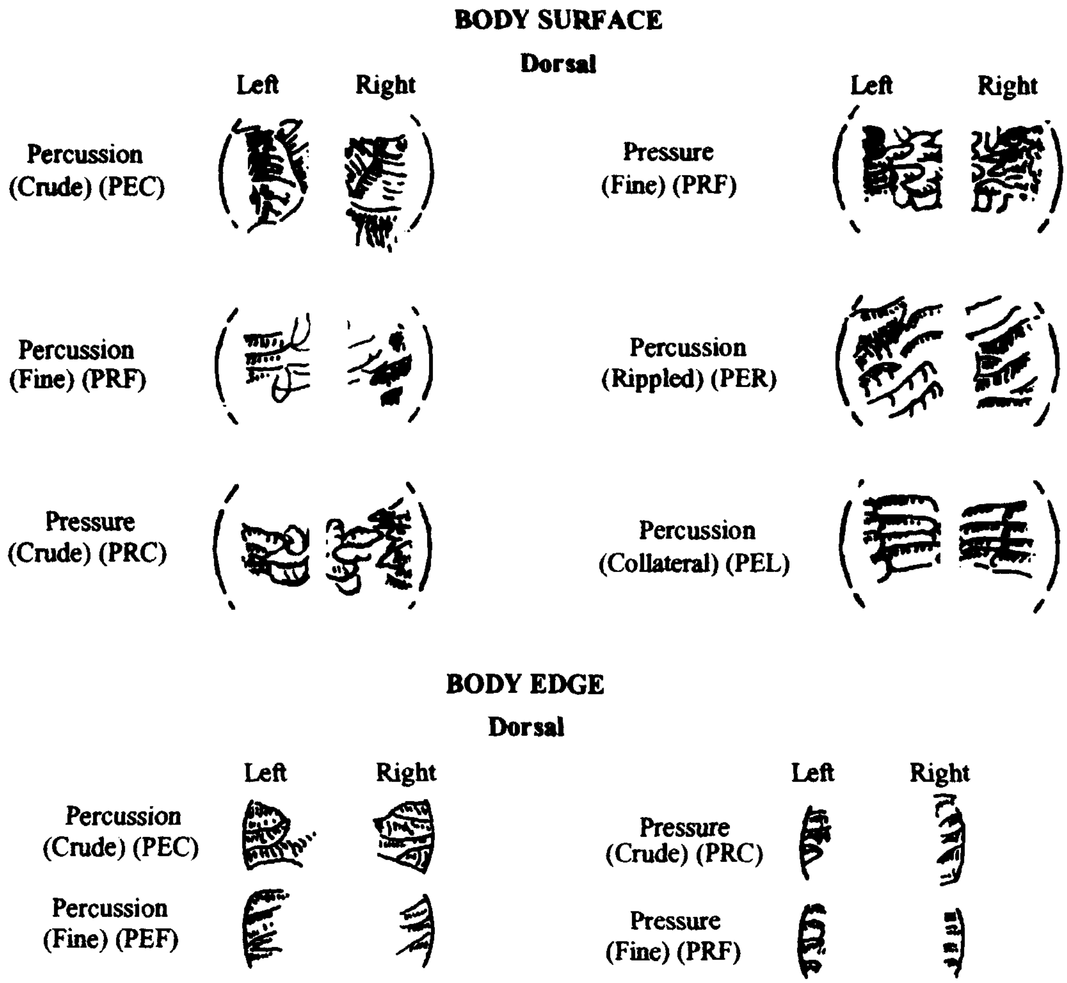


Figure IV-27. continued

proximal ends, but sometimes on their side or distal ends as well.

The smaller unifaces, our end scrapers, also broke into two groups. Those of small size with fine retouched bases or distal ends–the thumbnail, snub-nosed, and small flake–made up one type of this small class. The larger group was of medium size with less fine and less steep retouching; it included large flake end scrapers, gouges, and medium-sized plano-convex end scrapers.

Even during excavation in Todsen Cave it was apparent that these morphological attribute clusters had temporal significance. Most of our small snub-nosed end scrapers occurred in early levels, while the thumbnails appeared with late ceramic and the small flakes were in Late Archaic and ceramic times. Also, almost as soon as we laid out the other end scrapers on the lab table, they seemed to fall into three time periods. Large flake end scrapers occurred in diminishing amounts throughout the Archaic; gouges were Middle and Late Archaic and diminished in ceramic times; while plano-convex scrapers started in Late Archaic and seemed to increase in early ceramic times.

Their temporal significance was entirely different from that of the larger and more crudely chipped scraper planes, which seemed to characterize the Archaic, be absent in Paleo-Indian times and appear relatively infrequently in late ceramic times. The two most closely related types, large denticulates and pebble scraper planes, which often were

hard to distinguish from each other, had slightly different temporal distributions. The denticulates were dominant in the Early Archaic, popular in Middle Archaic times, and diminished in the Late Archaic. Pebble scraper planes also diminished in the Late Archaic and were popular in the Middle Archaic, but were different in being relatively rare in Early Archaic times. Both of these types contrasted with the later and flatter types; the flake scraper planes appeared as a minority type in the Middle and Late Archaic, while the domed ones seem to start in the Late Archaic and carry on into ceramic times. It was difficult to distinguish the flake scraper planes from the flake end scrapers, but the latter were larger and thicker and had cruder and steeper retouching. Domed scraper planes and small plano-convex disk end scrapers also blended into each other, but the latter were smaller, less conical, and had finer retouch. All in all, our scrapers were extremely sensitive time markers.

We attempted some use-wear analysis of these unifaces as well as blood residue studies in an attempt to determine if the changes of types reflected changes in function and use. In neither case were we very successful, although a few of the snub-nosed scrapers did give chemical reactions that might reflect the presence of blood or fat, suggesting they were used to scrape skins. However, we got no similar reactions for any other scrapers, including the related thumbnail or small flake end scrapers.

We also tried to use ethnographic analogy in our studies. Ethnographic analogy suggests gouges were used for woodworking, but microscopic use-wear studies gave no evidence of such use. Our scraper planes, also on the basis of ethnographic analogy, are thought to have been used for scraping plants. Both our blood residue and use-wear studies gave hints that such might be true, but the evidence was not very convincing. Similarly, denticulates often are thought to have been used on wood or fibrous materials, and these and the other scrapers could have been used to plane such plants as agave or opuntia. Certainly such types of plants were present in associated excavated levels and did show evidence of scraping, but real proof that our scraping planes did the job is lacking.

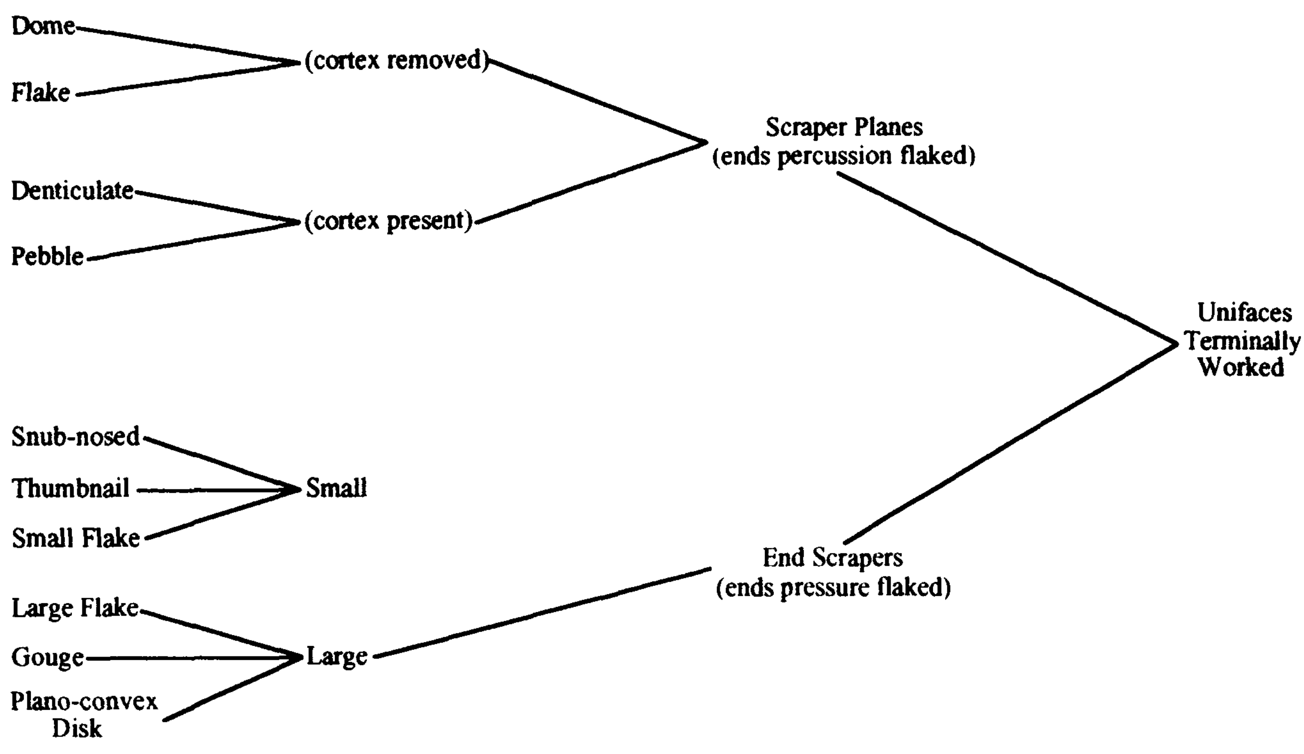


Figure IV-28. Cluster Analysis of Types of Terminally Worked Unifaces

Table IV-5. Correlation of Terminally Worked Uniface Types with Components in the Jornada Region

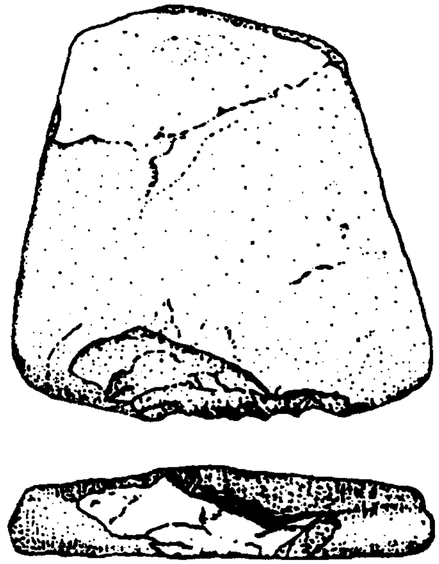
	Flat Pebble End Scraper	Snub-nosed End Scraper	Denticulate Scraper Plane	Pebble Scraper Plane	Large Flake End Scraper	Flake Scraper Plane	Domed Scraper Plane	Gouge	Small Plano-convex Disk	Small Flake End Scraper	Thumbnail End Scraper	TOTAL	PHASE
TOTAL	**8**	**26**	**50**	**22**	**47**	**17**	**26**	**26**	**43**	**42**	**19**	**326**	**EL PASO/DOÑA ANA**
LA5529, surface		4	4	1	2	3			2	6	1		
LA5531, surface									3				
LA5529, Zone A		1	3		1	1			4	1	1		
LA5531, Zone A		1	1				1						
LA5531, Zone B					1								
LA5531, Zone C							1			1	1		
LA5531, Zone D			1		1		2	2			2		
Rincon, level 1									1				
Peña Blanca, levels 3-4			7	7	17	3	13	13	13	15	9		
LA5531, Zone D1								2	1				
LA5531, Zone F+			1	2	4	1			3	2			**MESILLA**
Roller Skate, level 3							2		1				
Peña Blanca, level 6							2						
LA5529, Zone AB					1				3	1			
LA5531, Zone D2								3	4	1	2		
LA5531, Zone E								1	1				**HUECO**
LA5529, Feature 7								1	1	1			
LA5529, Zone upper B					1	2	1	1	4	5	2		
LA5529, Feature 5					1								
LA5531, Zone πJ		1	2	2	3	1	2	6	2	4			
LA5531, Zone F			2		1	1		3	3	1			**FRESNAL**
LA5531, Zone J		3	5	3	3		1			2			
LA5529, Zone middle B					1					1	1		
LA5529, Feature 2					1								
LA5531, Zone J1		1	1	1	1	1		2					
LA5529, Feature 6					2	1							
LA5529, Zone lower B	1	1		1	1	1	1						**KEY-STONE**
LA5531, Zone K		1	6	4	3	1							
LA5529, Feature 8		1	?	?		1							**GARDNER SPRINGS**
LA5529, Zone upper C		2	3		2								
LA5529, Feature 1		1	1										
LA5531, Zone K1		2	9	1									
LA5531, Zones M-N	4		1										**PRE-CLOVIS CLOVIS**
LA5529, Zone lower C	1	2	3										
LA5529, Zone D	1	3											
LA5529, Zone E	1												
PHASE	**GARDNER SPRINGS**					**KEYSTONE**		**HUECO/FRESNAL**			**CERAMIC**		

All in all our studies of the contextual and function or use aspects of our scrapers were most unsuccessful and unsatisfactory. We hope future analyses may improve our knowledge. In fact, our attempts at determining the spatial significance of our unifacial types not only was unsuccessful, but extremely frustrating. The Ventana Cave report was the one possible exception, but even here most of the similar types come from arbitrary levels in the middle den, and their exact cultural affiliations were difficult to determine. The Cochise sequence reports for both the Gila Drainage and the Mogollon Rim, which occasionally illustrate end scrapers and scraper planes, generally lack exact descriptions or records and/or charts of temporal distribution. The data from the Colorado Plateau are, if anything, even poorer.

Thus we have a long way to go in the Southwest on the most basic level of describing what has been found and when and where it occurs. While data on scrapers might not be so important for the ceramic levels no real understanding of the Archaic can be accomplished without this crucial first step. Southwestern archaeology, which has had the longest period of concentrated research of any area of the New World, thus has a basic vacuum that must be filled.

TYPE: FLAT PEBBLE END SCRAPER-CHOPPER

Source of
Drawings: North Mesa, zone E



(*drawings = ½ natural size)*

Sample

Excavation	8
Surface	4
Pictorial	0
Total	**12**

Description (based on a sample of 2)

Dimensions (in mm)

Maximum length	122.00	and	138.00
Maximum width	110.00		92.00
Maximum thickness	12.00		28.00
Distal to maximum body width	122.00		138.00
Distal to maximum thickness	60.00		80.00
Distal to minimum width	5.00		0

Form and Chipping Technique

Distal end: Convex unworked ends of pebbles.

Body and surface: Natural edges of flattened pebbles.

Basal junction: One is oblique rounded on the edge of the pebble, and one is right angle rounded.

Proximal end: These are steeply percussion chipped, unifacially retouched and slightly convex. One ventral edge shows evidence of chipping.

Relationships

Temporal and *Spatial:* At North Mesa, flat pebbles occurred in zone E, below what might be Clovis levels (D and lower C), which also had this type. They also were most numerous in the mixed gravelly zones M and N of Todsen Cave, below the Archaic levels. Thus they appear to be early in the Jornada region.

TYPE: SNUB-NOSED END SCRAPER

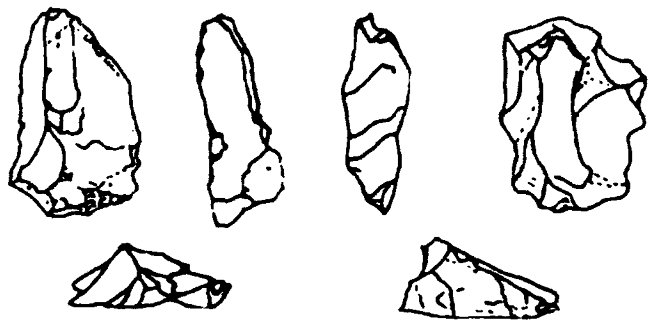
Source of
Drawings: North Mesa, lower zone E

(drawings = ½ natural size)

SNUB-NOSED END SCRAPER

Sample

Excavation	22
Surface	2
Pictorial	6
Total	**30**



(drawings = ½ natural size)

Description (based on a sample of 6)

Dimensions (in mm)

	Mean	**Range**
Maximum length	37.00	30.5-42.5
Maximum width	25.33	22.0-29.0
Maximum thickness	9.66	7.00-13.0
Distal to maximum body width	25.50	13.0-39.0
Distal to maximum thickness	21.50	12.0-29.0
Minimum thickness	4.00	3.00-5.50
Distal to minimum thickness	16.16	6.00-39.0
Minimum width	14.66	10.5-18.0
Distal to minimum width	4.00	3.50-4.50

Form and Chipping Technique

Distal end (tip): Form on the right and left is convex, forming a dull point. Chipping on the dorsal right and left mainly is crude percussion, but about 33% have fine percussion.

Body edge: Form of the right and left mainly is converging and most edges are convex (66%), but a few are straight (17%), sinuous (8%), and one is parallel sinuous (8%). Chipping on the dorsal right and dorsal left edges always is steep crude percussion.

Body surface: Form of the cross section distal to proximal usually is trianguloid with a proximal emphasis (66%) or truncated (33%), while cross section left to right usually is truncated. Dorsal chipping is crude percussion, while the ventral surface usually is a single flake scar.

Basal junction: Form usually is slightly convex (100%). Chipping on the dorsal surface usually is steep fine percussion or crude pressure.

Area of use-wear: Always the convex steeply retouched base at the junction of ventral and dorsal surfaces.

Relationships

Temporal: As far as the Jornada sequence is concerned, snub-nosed end scrapers are mainly Paleo-Indian and Early Archaic. This distribution could well reflect the greater amounts of skins fleshed, since the numerous kills made in early times diminished in the Archaic and later times. Also, the custom of hafting these end scrapers may have been more common in early times, but with decreasing skin scraping such may have diminished or stopped.

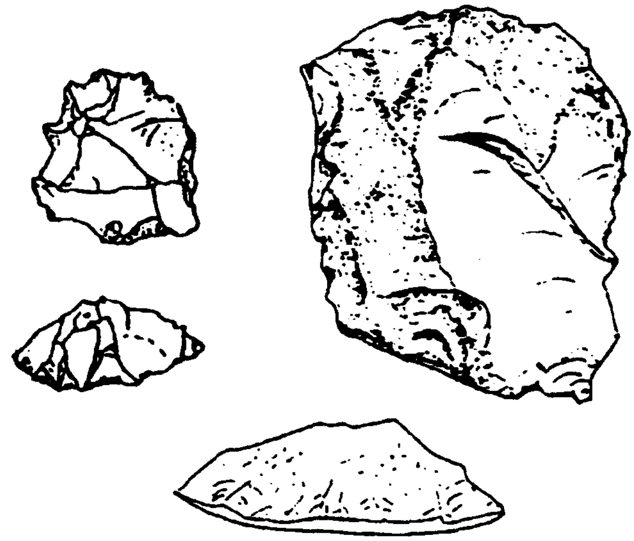
Spatial: This type seems widespread in the Southwest (Dick 1965, figure 35; Haury 1950, figures 36e-g), and perhaps everywhere in Paleo-Indian times (Waters 1986, figures 44e and f).

TYPE: DENTICULATED LARGE SCRAPER PLANES

Source of
Drawings: Todsen Cave, zone K1

Sample

Excavation	45
Surface	5
Pictorial	6
Total	**56**



(drawings = ½ natural size)

Description (based on a sample of 6)

Dimensions (in mm)

	Mean	Range
Maximum length	86.4	37.0-107.0
Maximum width	81.8	34.0-104.0
Maximum thickness	31.2	14.00-52.0
Distal to maximum body width	68.2	13.0-100.0
Distal to maximum thickness	36.8	13.00-65.0
Minimum thickness	10.2	5.00-15.00
Distal to minimum thickness	48.0	3.00-100.0
Minimum width	52.0	13.00-68.0
Distal to minimum width	39.4	9.00-87.00

Form and Chipping Technique

Distal end (tip): Both right and left, usually convex (50%), a few are oblique pointed (25%), deeply convex (12%), and rarely straight (12%). Chipping on the dorsal right and left mainly is steep crude percussion (60%), but 30% are fine percussion and 10% are crude pressure

Body edge: Usually converging on both the right and left with some convex (34%), straight (33%), and deeply convex (33%). Chipping on the dorsal right is notched, creating points between the notches or denticulates, as well as crude percussion; dorsal left is fine pressure (55%), notched (33%), crude pressure (8%), and crude percussion (4%), but always relatively steep.

Body: Cross section both distal to proximal and left to right mainly is plano-convex.

Body surface: Chipping dorsally always is crude percussion but some parts still may have the cortex, bear a single flake scar or, at most, two.

Basal junction: Usually obtuse rounded (66%) or right angle rounded (34%), both right and left.

Proximal end (base): Usually deeply convex (50%), or convex (33%), rarely straight (17%). Chipping on the dorsal base often is notched, creating denticulates, but one base had crude percussion that created concavities between points; only one has crude percussion, but a lateral edge is notched.

Area of use-wear: Usually proximal end, but one sample is both proximal and lateral, while one is only lateral.

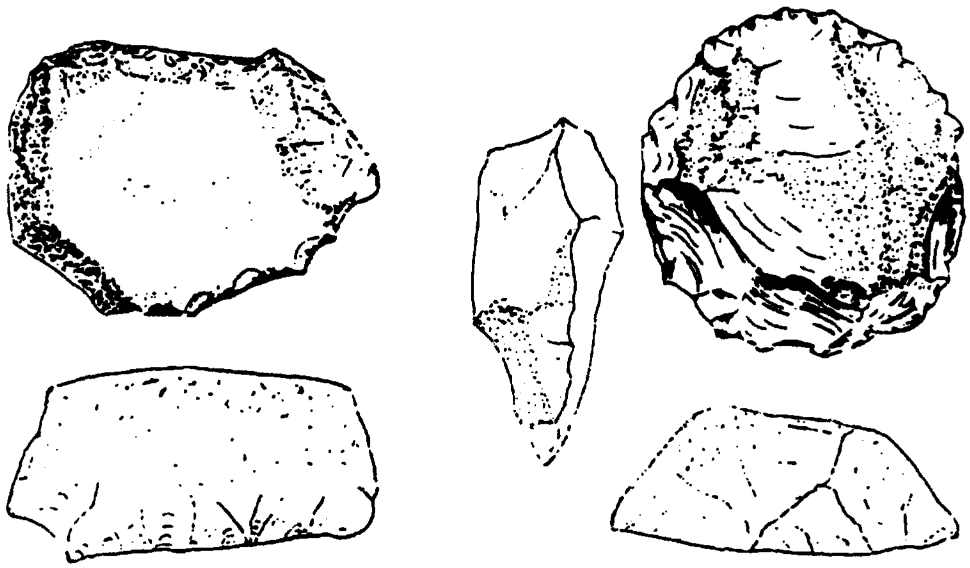
Relationships

Temporal: Denticulated large scraper planes do not seem to occur in Paleo-Indian times, but become dominant in the Early Archaic and diminish in later times in the Jornada region.

Spatial: Their spatial distribution is documented poorly for the rest of the Southwest (Sayles 1983); none are il-

lustrated for Ventana (Haury 1950) or Bat Cave, but some occurred in Tularosa and Cordoba caves (Martin et al. 1952, figure 58i). Ethnographic analogy suggests many of these scraper planes were woodworking or fiber-scraping tools. Our use-wear studies were not complete enough to indicate whether any of ours were used for these purposes.

TYPE: PEBBLE SCRAPER PLANE



(drawings = ½ natural size)

Sources of Drawings: Todsen Cave: left, zone J; right, zone πJ

Sample

Excavation	22
Surface	1
Pictorial	6
Total	**29**

Description (based on a sample of 4)

Dimensions (in mm)

	Mean	**Range**
Maximum length	73.62	56.0-96.5
Maximum width	71.50	54.5-87.0
Maximum thickness	38.25	26.0-44.0
Distal to maximum body width	38.00	29.0-50.0
Distal to maximum thickness	24.37	0-35.0
Minimum thickness	16.50	5.00-35.0
Distal to minimum thickness	41.62	5.00-92.5
Minimum width	33.50	15.0-61.0
Distal to minimum width	30.50	7.00-64.0

Form and Chipping Technique

Distal end (tip): Form on the right and left is deeply convex (100%). Chipping on the dorsal right and left mainly is crude percussion with one exception that seems crude pressure (20%).

Body edge: Form on the right is converging convex (60%) to straight (40%) and on the left parallel straight (50%) to convex (50%). Chipping on the dorsal right and left mainly is crude percussion, but 20% have no chipping and cortexes showing while one sample has crude pressure (10%).

Body surface: Form on the cross section distal to proximal mainly is plano-convex (80%), although a few samples are plano-plano (20%). Cross section left to right mainly is prismatic (66%), but some are plano-convex (33%). Chipping on the dorsal surfaces, when it appears, is crude percussion (66%), but on some the cortex still shows (34%). All ventral surfaces are single scars.

Basal junction: Form on the right and left mainly is obtuse rounded (100%) since the general outline form is ovoid.

Proximal end (base): This basal form, like the distal end, mainly is steeply convex (66%), but on some, because of retouch, the form is only slightly convex (34%). Chipping on the dorsal on all specimens is crude steep pressure flaking.

Area of use-wear: Proximal end only.

Relationships

Temporal: These pebble scraping planes do not seem to occur in Paleo-Indian sites, but appear in the Early Archaic, reaching a zenith in Keystone times and then diminishing in the Jornada region.

Spatial: These seem to occur in the Oshara tradition from San Jose to En Medio times (Irwin-Williams 1973, figure 40). They also seem common in the Cochise tradition from Sulphur Springs (Waters 1986, figures 4, 5d-f) to San Pedro (Sayles 1983, figure 9; Dick 1965, figure 27) and are common in western Arizona and the adjacent California desert (Haury 1950, figure 40).

TYPE: LARGE FLAKE END SCRAPER

Sources of
Drawings: Todsen Cave: left, zone F; right, zone J

(drawings = ½ natural size)

Sample

Excavation	44
Surface	4
Pictorial	6
Total	**54**

Description (based on a sample of 4)

Dimensions (in mm)

	Mean	Range
Maximum length	63.4	45.0-74.0
Maximum width	41.2	32.0-50.0
Maximum thickness	17.2	14.0-22.0
Distal to maximum body width	36.4	27.0-43.0
Distal to maximum thickness	25.0	0-48.0
Minimum thickness	5.6	4.00-8.00

	Mean	Range
Distal to minimum thickness	21.4	4.00-54.0
Minimum width	33.2	22.0-44.0
Distal to minimum width	29.6	5.00-64.0

Form and Chipping Technique

Distal end (tip): Form on the right and left mainly is deeply convex (75%), but sometimes oblique straight (25%). Chipping on the dorsal right and left, when it is not the end utilized, is crude percussion (50%); if used (50%), it usually is crude pressure (66%), but may be fine, steep percussion (34%).

Body edge: Form on both the right and left usually is roughly parallel, but varies considerably from straight (50%) to concave (25%) and sinuous (25%). Chipping on the dorsal right and left usually is crude pressure, although half the samples have no chipping (so the cortex shows), while a few have crude pressure (10%), usually adjacent to the end retouched.

Body surface: Form on the cross section distal to proximal usually is plano-convex (75%), but a few are triangular (25%) with the emphasis towards the retouched end. Cross section left to right always is plano-convex. Chipping on the dorsal surface always is crude percussion, and the ventral surface is one or two large scars.

Basal junction: Form usually is obtuse (75%) or right angled (25%), often rounded on the right and left corners.

Proximal end (base): Form often is straight or straightish (80%), but a few are slightly convex (10%) or sinuous (10%). Chipping on the dorsal usually is steep pressure crude or percussion fine if this is the end utilized; if not utilized, it is crude sloping percussion.

Area of use-wear: Either the proximal (40%), or distal (40%), but sometimes both (20%).

Relationships

Temporal: Flake end scrapers occur throughout the Archaic from Keystone to Hueco times.

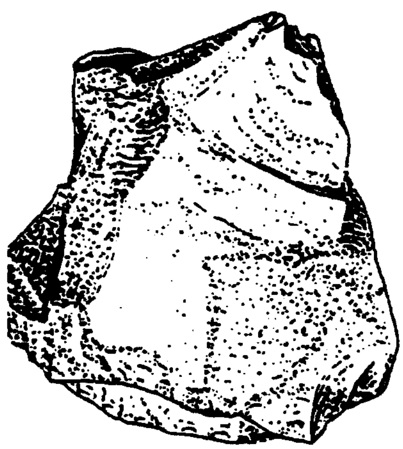
Spatial: They may occur in the Oshara tradition, but few examples have been described or illustrated. They are, however, numerous in the Cochise tradition, appearing as a minority type in Sulphur Springs (Waters 1986, figure 4.4a). They are numerous in Chiricahua (Sayles 1983, figure 9.4; Martin et al. 1952, figure 57) and seem to die out in San Pedro (Dick 1965, figures 34a-c). They are common in California and western Arizona (Haury 1950, figures 40c-d).

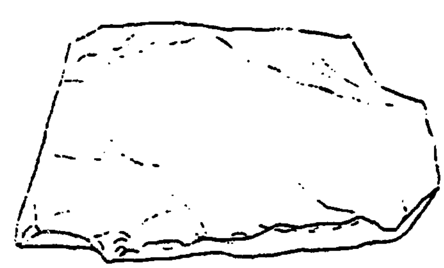
TYPE: FLAKE SCRAPER PLANE

Source of Drawings: Todsen Cave, zone F

Sample

Excavation	13
Surface	4
Pictorial	1
Total	**18**





(drawings = ½ natural size)

Description (based on a sample of 3)

Dimensions (in mm)

	Mean	Range
Maximum length	91.66	66.0-111
Maximum width	80.66	63.0- 97.0
Maximum thickness	38.00	30.0- 50.0
Distal to maximum body width	62.00	13.0-104
Distal to maximum thickness	44.00	5.00-74.0
Minimum thickness	18.00	14.0-32.0
Distal to minimum thickness	55.56	39.0-65.0
Minimum width	52.00	30.0-66.0
Distal to minimum width	27.33	17.0-39.0

Form and Chipping Technique

Distal end (tip): The form is oblique straight (66%), or straight (34%) right and left. Chipping on the dorsal right and left always is crude percussion, but about a third of the sample have no chipping.

Body edge: Form slightly converging (66%) to parallel (34%) on both the right and left and may vary from slightly convex to straight to concave. Chipping on the dorsal right and left usually is crude percussion.

Body surface: Form cross section distal to proximal often is plano-plano (50%), or truncated (30%), and only occasionally triangular with a proximal emphasis (20%). Cross section left to right usually is truncated. Chipping dorsally is crude percussion; ventrally it usually is a single scar.

Basal junction: Since the general form is ovoid (66%), to oblong (34%), the form right and left usually is obtuse or right angled, and usually rounded.

Proximal end (base): Form usually is straight (60%), to slightly convex (20%), or concave (20%). Chipping dorsally always is steep and varies from fine pressure or percussion to crude percussion.

Area of use-wear: Always on the proximal end.

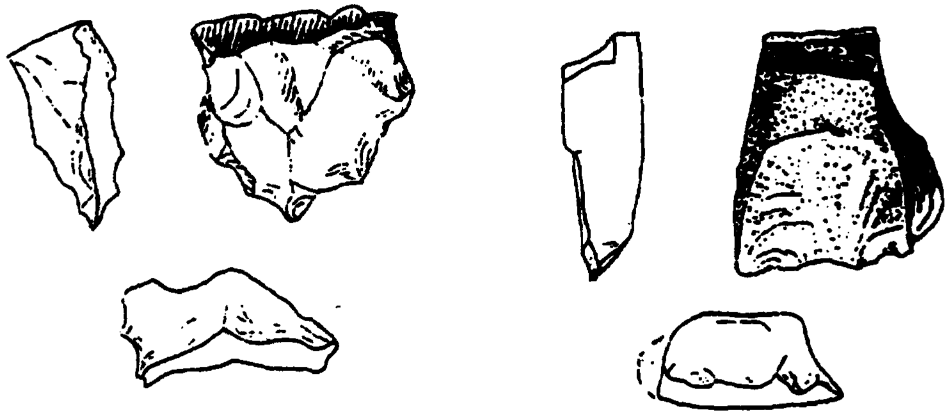
Relationships

Temporal and *Spatial:* In the Jornada region flake scraper planes are most popular in Keystone and Fresnal times. They also seem popular in the Middle Archaic San Jose phase in the Oshara tradition (Irwin-Williams 1973), but might be common throughout the Cochise sequence (Waters 1986, figure 4.4; Sayles 1983, figure 9.4; Martin et al. 1952, figure 88; Dick 1963, figure 84). They also occur in the Archaic in the California desert (Haury 1950; Rogers 1939).

TYPE: GOUGE

Sources of Drawings: Todsen Cave:
left, zone πJ;
right, zone J

(drawings = ½ natural size)



Sample

Excavation	19
Surface	5
Pictorial	8
Total	**32**

Description (based on a sample of 6)

Dimensions (in mm)

	Mean	Range
Maximum length	61.6	49.0-119.0
Maximum width	57.0	48.0-70.0
Maximum thickness	21.4	15.0-29.0
Distal to maximum body width	40.6	18.0-55.0
Distal to maximum thickness	31.2	6.00-81.0
Minimum thickness	8.6	5.00-15.0
Distal to minimum thickness	26.2	4.00-51.0
Minimum width	30.0	12.0-59.0
Distal to minimum width	14.0	4.00-101.0

Form and Chipping Technique

Distal end (tip): Generally speaking form is pointed (50%), convex (33%), or oblique (17%). Chipping, when it exists (50%), is mainly crude percussion (50%) both dorsal right and left, but crude pressure and fine percussion also occur.

Body edge: Usually parallel (66%), or slightly converging (33%), as form ranges from truncated triangular to oblong, so the form of the right edge is converging right or parallel straight to convex, as is the left edge, except for two samples that are concave because this is the cutting edge. Chipping on both the dorsal right and left, when it occurs (50%), is mainly crude percussion, except on two samples where the left edge was used for gouging, and these have steep crude pressure flaking.

Body surface: Form cross-section distal to proximal and left to right is mainly plano-convex. Chipping on the dorsal is mainly crude percussion, while ventral chipping is a single scar.

Basal junction: Generally rounded, and the form of the right junction is obtuse (55%), or right angled (44%), and left angled from obtuse (66%) to acute (34%).

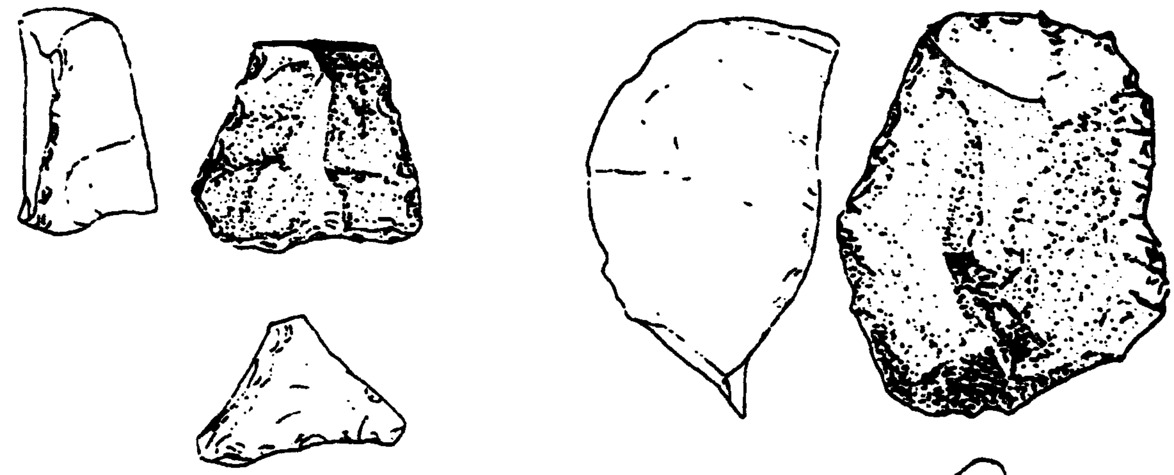
Proximal end (base): Form is deeply concave (50%) or sinuous-S or sinuous-Z (33%); the only ones slightly convex are those that had their lateral edges used for gouging (17%). Chipping on the dorsal is mainly crude pressure, except for the two with lateral gouging edges, which have crude percussion.

Area of use-wear: Usually proximal ends (66%), but some were used on one lateral edge.

Relationships

Temporal and *Spatial:* Although gouges first appear in Fresnal times, they are most popular in the Late Archaic. They are very common in the Middle and Late Archaic in Texas (Hester 1980, figure 5.13) and do seem to occur in Oshara in En Medio-Armijo times (Irwin-Williams 1973, figure 5n). Whether they occur in Cochise is problematical, but Sayles illustrates a few that could be gouges (1983, figure 9.4), as does Haury (1950, figures 38c-i).

TYPE: DOMED SCRAPER PLANE



Source of Drawings: Todsen Cave, zone D

(drawings = ½ natural size)

Sample

Excavation	26
Surface	5
Pictorial	6
Total	**37**

Description (based on a sample of 3)

Dimensions (in mm)

	Mean	Range
Maximum length	70.25	48.0-86.0
Maximum width	59.25	35.0-46.0
Maximum thickness	50.00	32.0-65.0
Distal to maximum body width	44.75	15.0-68.0
Distal to maximum thickness	39.50	0-65.0
Minimum thickness	16.25	11.0-23.0
Distal to minimum. thickness	12.50	9.00-16.0
Minimum width	36.50	24.0-53.0
Distal to minimum width	37.25	4.00-82.0

Form and Chipping Technique

Distal end (tip): Form on the right and left is mainly oblique straight (66%), often making these scraper planes vaguely pointed to slightly convex. Chipping on the dorsal right and left, more than half the time (when used for the scraping edge), is fine percussion (60%); when not, it is crude percussion.

Body edge: Form may be either parallel (33%), or converging (67%), and then right and left may be straight to slightly convex, making them truncated triangular in general form. Chipping on the dorsal right and left, when it occurs (40%), is crude percussion.

Body surface: Form of the cross-section distal to proximal is usually triangular (66%), with both distal (66%) and

proximal (33%) emphasis, while cross-section left to right is usually truncated. Chipping, in contrast to the pebble type, rarely has cortex showing on the dorsal surface. Usually chipping is crude percussion, often radially done, while the ventral surface bears one or occasionally two large scars.

Basal junction: Form on the right and left is often acute (67%), or right angled (33%), since the overall form is truncated and may be rounded or angled.

Proximal end (base): Form varies considerably, but may be straight (34%), sinuous-S (33%), or slightly concave or convex (33%). The chipping dorsally is usually crude percussion, except in the rare case when this is the cutting edge (25%), and then it is steep fine percussion.

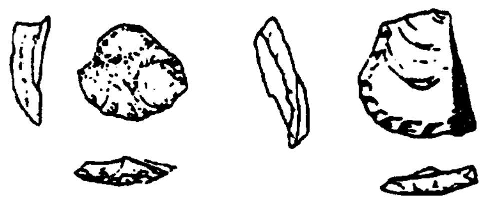
Area of use-wear: Unlike many of the other unifaces, the distal end (75%) more often is utilized than the proximal end (25%).

Relationships

Temporal and *Spatial:* In the Jornada region domed scraper planes are mainly Late Archaic (Hueco phase), but carry on into Mesilla ceramic times. They are rare or absent in Oshara, but occur in Cochise (Sayles 1983, figures 9.4gg and 10.4y) in the Chiricahua and San Pedro phases (Dick 1965, figures 2le and f). There are hints they occur in western Arizona and California (Haury 1950, figure 40a).

TYPE: SMALL FLAKE END SCRAPER

Source of Drawings: North Mesa, zone B



(drawings = ½ natural size)

Sample

Excavation	26
Surface	6
Pictorial	2
Total	**34**

Description (based on a sample of 3)

Dimensions (in mm)

	Mean	**Range**
Maximum length	40.66	39.0-43.0
Maximum width	29.33	19.0-44.0
Maximum thickness	10.00	7.00-13.0
Distal to maximum body width	20.33	17.0-22.0
Distal to maximum thickness	10.00	5.00-14.0
Minimum thickness	4.00	3.00-5.00
Distal to minimum thickness	23.66	8.00-32.0
Minimum width	18.00	7.00-34.0
Distal to minimum width	15.33	1.00-38.0

Form and Chipping Technique

Distal end (tip): Varies considerably, but the form on the right and left edges often is convex (60%); it also may be straight (20%), or even slightly concave (20%). Chipping on the dorsal right and left is usually crude percussion, unless the distal (usually convex) end has been utilized and, if so, the end may have fine percussion chipping.

Body edge: Edges vary considerably, but generally are ovoid (60%), or oblong (34%), so the form of right and left vary considerably; more are parallel than converging and more slightly convex than straight or concave. Chipping on the dorsal right and left edge is often crude pressure (50%), but some have percussion (30%), and some have no chipping (20%).

Body surface: Form of the cross section distal to proximal and left to right usually is plano-convex (70%), but a few may be plano-plano (20%), or truncated (10%). Chipping dorsally is usually crude percussion.

Basal junction: Form is varied but mainly slightly convex (67%) to straight (33%). Chipping on the dorsal, except for those used on the distal end, is usually crude pressure flaking and is not very steep.

Proximal end (base): Mainly slightly convex (67%), or deeply convex (33%).

Area of use-wear: Usually the proximal end, but about a third show wear on the distal end.

Relationships

Temporal and *Spatial:* Small flake end scrapers appear in Middle Archaic times and last into ceramic times in the Jornada region. They are a very general type and appear in Cochise (Dick 1965, figures 34d and e; Martin et al. 1952, figure 58; Sayles 1983, figures 9.4x-aa) as well as Oshara (Irwin-Williams 1979). They also are common in the deserts of western Arizona and California (Haury 1950, figures 29e-j and 36a-d) as well as in Texas (Turner and Hester 1985).

TYPE: SMALL PLANO-CONVEX DISK

Sources of Drawings: Left, Todsen Cave, surface; right, North Mesa, surface

(*drawings = ½ natural size*)

Sample

Excavation	38
Surface	3
Pictorial	2
Total	**43**

Description (based on a sample of 6)

Dimensions (in mm)

	Mean	Range
Maximum length	46.00	38.0-58.0
Maximum width	37.50	32.0-41.0
Maximum thickness	21.33	14.0-23.0
Distal to maximum body width	28.50	25.0-33.0
Distal to maximum. thickness	28.00	18.0-34.0
Minimum thickness	7.33	3.00-12.0
Distal to minimum thickness	24.66	6.00-56.0
Minimum width	19.33	6.00-25.0
Distal to minimum width	16.16	4.00-58.0

Form and Chipping Technique

Distal end (tip): Since they all are conical objects that might be seen as small scraping planes, the form of both right and left distal ends is usually convex (50%), with a few samples deeply convex (25%), or oblique pointed (25%). Chipping of the dorsal right and left is mainly relatively steep crude pressure flaking on about half, while the rest have crude percussion (33%), or no chipping (17%).

Body edge: The form on both the right and left is mainly convex. Chipping on the dorsal right and left is mainly crude percussion (75%), except for disks whose edges have been utilized (25%), which have crude pressure; one of these is done so strongly it has notches, creating denticulates.

Body surface: Form for both cross-section distal to proximal and left to right is mainly plano-convex (83%), but some are truncated (17%), and one is triangular with a distal emphasis. Chipping dorsally is crude percussion, often done in a radial pattern that makes these more or less conical.

Basal junction: Because of their general ovoid or round shape, both right and left are oblique rounded.

Proximal end (base): Usually slightly convex (50%), but a few are deeply convex (33%) and a few are straightish (17%), because of steep pressure flaking making a cutting edge. Chipping on the dorsal usually is crude (80%), but sometimes there is steep pressure flaking (20%).

Area of use-wear: Usually more than one edge has been utilized–proximal to lateral (25%), distal proximal (17%), opposite lateral sides (17%)–but occasionally use-wear appears on only one edge–proximal, distal, or lateral.

Relationships

Temporal and *Spatial:* Plano-convex disks mainly are a Hueco-Mesilla type in the Jornada region. They appear in the Late Archaic in Oshara in the Colorado Plateau (Morris and Burgh 1954, figure 83; Irwin-Williams and Irwin 1966, figure 22). Some also occur in Late Archaic times in the Mogollon area (Dick 1965; Martin et al. 1952, figure 54) as well as in western Arizona (Haury 1950, figures 32 and 28; Sayles 1983, figures 9.4bp-d).

TYPE: THUMBNAIL END SCRAPER

Source of
Drawings: Todsen Cave, zone C

Sample

Excavation	18
Surface	1
Pictorial	3
Total	**22**

(drawings = ½ natural size)

Description (based on a sample of 2)

Dimensions (in mm)

	Range
Maximum length	14.0-16.0
Maximum width	9.00-11.0
Maximum thickness	2.00-3.00
Distal to maximum body width	14.0-16.0
Distal to maximum thickness	2.00-5.00
Minimum thickness	1.00-2.00
Distal to minimum thickness	14.0-16.0

	Range
Minimum width	7.00-9.00
Distal to minimum width	2.00-6.00

Form and Chipping Technique

Distal end (tip): Form on both the right and left is deeply convex. Chipping on both the dorsal right and left is fine pressure.

Body edge: Form on the right and left is converging slightly convex or converging straight. Chipping on the dorsal right and left is crude percussion.

Body surface: Form of the cross-section distal to proximal is triangular with a distal emphasis or convex-concave; the cross-section left to right is triangular or convex-concave. Chipping on the dorsal is a couple of longitudinal flake scars.

Basal junction: Form on both the right and left is right angle rounded or acute.

Proximal end (base): Form is straight to convex. Chipping on the dorsal is crude percussion.

Area of use-wear: Distal end.

Relationships

Temporal and *Spatial:* In the Jornada region thumbnail end scrapers occur mainly in ceramic times, but first appear in the Hueco phase. Their distribution in the Mogollon region is similar (Martin et al. 1952) as it is in the Gila region (Sayles 1983, figure 10.4; Haury 1950, figure 39). In the Colorado Plateau they appear to have a similar temporal range (Irwin-Williams and Irwin 1966, figure 32; Parry and Christensen 1987). This trend toward thumbnail scrapers in late prehistoric times seems widespread in North America; our Southwestern data may reflect a regional occurrence of this general trend.

Section 4

Laterally Worked Unifaces

Of all the classes of chipped stone tools, the laterally worked unifaces, also known as side scrapers, are the most numerous from excavation (492 specimens). However, only a few of our types show significant trends or are good time or space markers. Also, the clusters are not marked very well. I am sure other attributes, including ones that concern use-wear, might show other attribute clusters that have greater temporal and spatial significance. For the present, we shall describe our types in the hope that these data may be useful to future investigators who will do the sort of analysis that will improve the situation.

The basic orientation of the laterally worked artifacts and the attributes of form were the same as for the terminally worked unifaces and other bifaces. Measurement and chipping technique attributes also were the same and we recorded those attributes on the same sort of cards as those for terminally worked unifaces, using these as the basis for our comparisons to determine attribute clusters (see Figure IV-29).

On the grossest level the 492 specimens studied fell into two general groups: those with distal ends worked to points and those that did not have pointed ends. The pointed group included three general classes–blades whose distal ends were more or less pointed because of their striking platforms; flakes with their tips or distal ends chipped to a point, such as gravers; and small and large pointed unifacial drills that had both distal ends and two or more adjacent sides chipped so as to make points. As we shall see most, if not all, of these attribute clusters showed temporal significance.

This significance was not true of all of the nonpointed group. The largest group was made up of those with a convex retouched edge (or edges from 10 percent to 20 percent of the total). Both the large and small convex types formed large groups throughout the sequence, with the large ones being more dominant in the earliest levels. Pebble side scrapers occurred mainly in the earliest Archaic levels and back-blunted (often semilunar) unifaces were most popular in Keystone times. In both cases, however, our samples and/or number of specimens were small. The unifaces with concave edges became popular only in Late Archaic or ceramic times (but again, our sample was small). Vaguely related to them were the denticulated side scrapers or unifacial saws; although not represented by large samples, they seem to appear in late Paleo-Indian times and last into the early part of the Middle Archaic, the Keystone phase.

Obviously, these different types of laterally worked unifaces had a variety of functions and uses. Some of these functions are obvious from ethnographic analogy, with the pointed ones used for drilling, piercing, and engraving and the nonpointed ones for cutting, slicing, sawing, and scraping. However, exact determination of their uses or functions requires use-wear studies, and ours were too incomplete to give reliable results. Thus future analysis needs to be done; this should include the study of the many flakes that did not have obvious retouch, for John Shea's examination of some of these under a microscope indicated a high proportion had been utilized for a variety of tasks. Until such studies are done, our conclusions about culture activities at any one occupation, or even culture phase, will be tentative and preliminary. However, our preliminary analysis concerning types–perhaps we should say "trial types"–does show chronology and helps define our cultural phases, as described on the following pages.

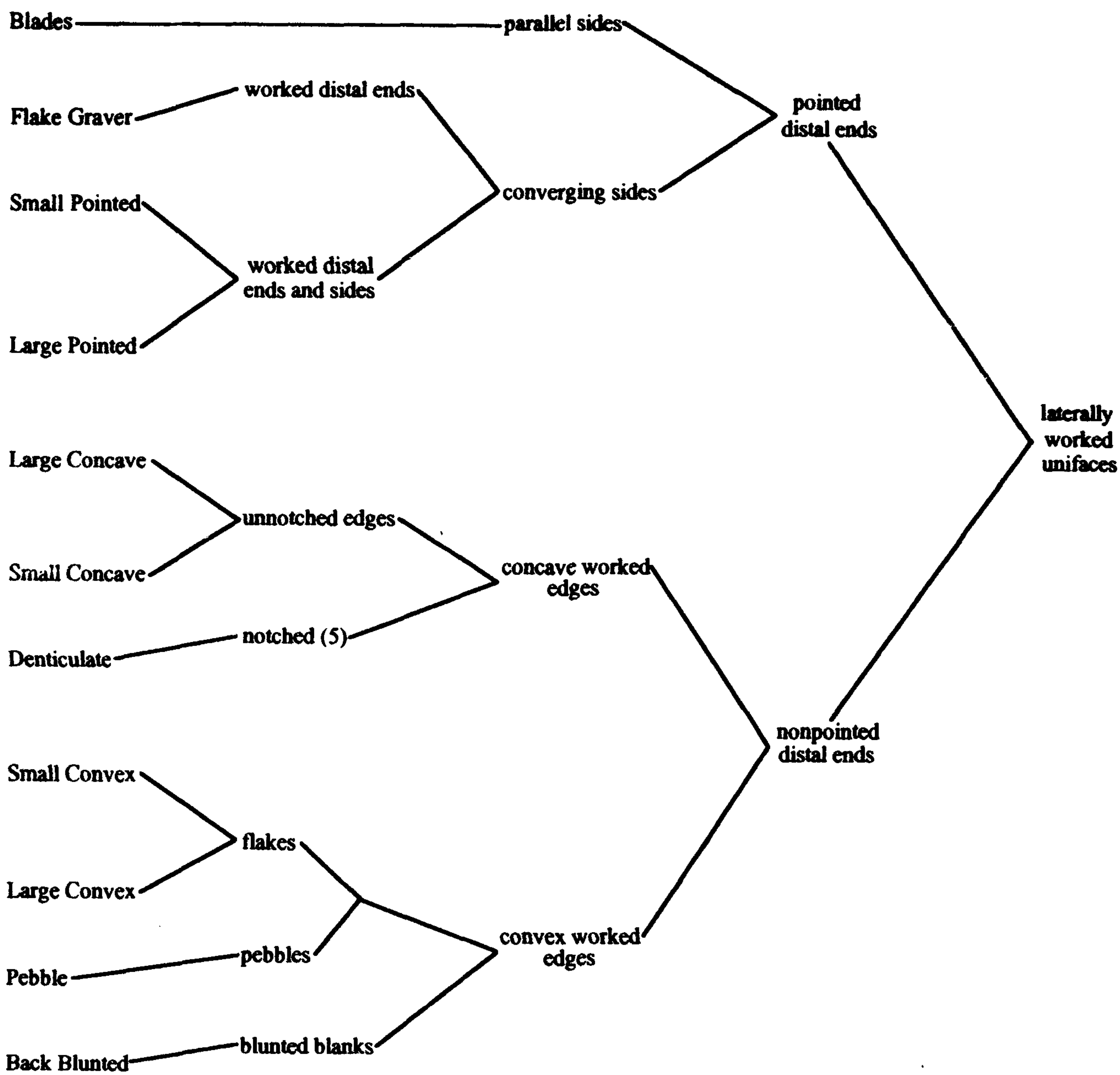


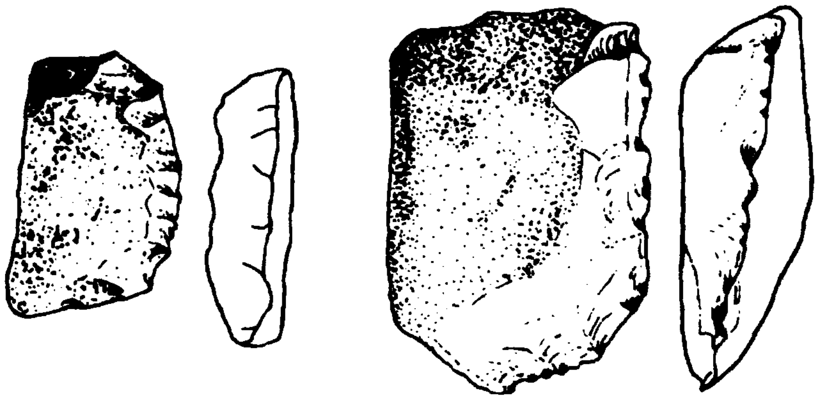
Figure IV-29. Cluster Analysis of Laterally Worked Unifaces

Table IV-6. Correlation of Laterally Worked Uniface Types with Components in the Jornada Region

	Pebble Side Scraper	Crude Blade	Flake Graver	Large Convex Uniface	Large Denticulate (mw)	Small Convex Uniface	Large Concave Uniface	Small Concave Uniface	Backblunted Side Blade	Large Pointed Uniface	Small Pointed Uniface	TOTAL	PHASE
TOTAL	**18**	**102**	**3**	**101**	**43**	**93**	**68**	**22**	**14**	**17**	**11**	**492**	
LA5529, surface		1		3		1	1		2	1			EL PASO/DOÑA ANA
LA5531, surface		1							1				
LA5529, Zone A		3		3	3	7	3	3		1	1		
LA5531, Zone C		1		2		4				2			
L5531, Zone D	1	11		2	2	5	3	2	1	2	2		
LA5531, Zone D1		3				1	1			1			
LA5531, Zone F+	1	10		11	2	14	5	2		1	1		MESILLA
LA5529, Zone AB		1		2	1	2	2	1					
LA5531, Zone D2		3		2	1	4	3			1			
LA5529, Feature 12				1			1						
Sonrisa, level 2				1									
LA5531, Zone E							1		1		1		HUECO
LA5529, Feature 7				2									
LA5529, Zone upper B		2		5	2	4	5	2	1	2	2		
LA5529, Feature 3				1		1							
Roller Skate, level 6				2									
LA5529, Feature 5		1		1		1	1						
Tornillo, Zone A1				1									
LA5531, Zone E1				1									
Knee Pad, level 3				1									
LA5531, Zone πJ		16		14	5	7	19	2		2	3		
LA5531, Zone F		1		1	1	3	1	1	1				FRESNAL
LA5531, Zone J		9		5	5	9	10	1	1	2			
Tornillo, Zone B						1							
Tornillo, Zone C				1									
LA5529, Zone middle B	1	5		6	2	1	1	1					
LA5529, Feature 2							1				1		
LA5531, Zone J1		10		8	2	7	3	3	2	2			
LA5529, Feature 9						1							
LA5529, Feature 6		2			1	1							
LA5529, Feature 4						1							KEYSTONE
LA5529, Feature 11				1	1	1							
LA5529, Zone lower B		1		3		1							
LA5531, Zone K	3	9		8	7	7	6	2	4				
LA5529, Feature 8						1							GARDNER SPRINGS
LA5529, Zone upper C	1	2		1	2	2							
LA5529, Feature 1		1		1	1	2							
LA5531, Zone K1	1	5		8	2	2	1	2					
LA5531, Zones M-N	5	1											PRE-CLOVIS CLOVIS
LA5529, Zone lower C	3	1	2	3	3	2							
LA5529, Zone D	1		1										
LA5529, Zone E	1	2											

TYPE: PEBBLE SIDE SCRAPER (UNIFACIAL CHOPPER)

Sources of
Drawings: Right, North Mesa, zone E;
left, Todsen Cave, zone K



Sample

Excavation	18
Surface	2
Pictorial	2
Total	**22**

(drawings = ½ natural size)

Description (based on a sample of 3)

Dimensions (in mm)

	Mean	Range
Maximum length	96.0	74.0-110.0
Maximum width	59.0	44.0-68.0
Maximum thickness	37.0	24.0-40.0
Distal to maximum body width	68.0	40.0-84.0
Minimum width	17.0	16.0-21.0
Distal to maximum body thickness	37.0	16.0-72.0
Minimum thickness	7.0	6.00-8.00

Form and Chipping Technique

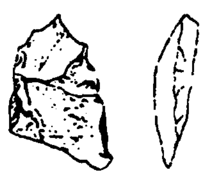
Tip: Not chipped on the distal edges, which are the slightly convex pebble ends.
Body edge: All have been chipped uniformly by steep percussion blows on the dorsal surface.
Body: Surface back–ventral (relatively flat) and dorsal (relatively convex)–is unchipped.
Basal junction: Roughly right angle rounded and unchipped.
Proximal end (base): Slightly convex to straight and unchipped.
Area of use-wear: One lateral edge.

Relationships

Temporal and *Spatial:* In the sequence at Todsen and North Mesa, pebble side scrapers occur mainly in the earliest levels. Unfortunately, other descriptions of similar tools are so limited it is difficult to determine their distribution or temporal occurrence in the Southwest.

TYPE: FLAKE GRAVER

Source of
Drawings: North Mesa, zone D



(drawings = ½ natural size)

Sample

Excavation	3
Surface	2
Pictorial	4
Total	**9**

Description (based on 1 whole specimen)

Dimensions (in mm)

	Mean
Maximum length	42.0
Maximum width	42.0
Maximum thickness	6.0
Distal to maximum body width	36.0
Distal to maximum thickness	42.0
Minimum thickness	1.0
Distal to minimum thickness	1.0
Minimum width	0.5

Form and Chipping Technique

Distal end: All flake gravers have short, acute points that have been pressure retouched (often fine) to make a graving edge. It usually is on the dorsal surface, but sometimes opposite sides are on opposite surfaces.

Body edge: All samples are converging; they range from convex to straight and bear a few rough percussion scars on the dorsal side.

Body surface: In cross-section longitudinally, all are roughly triangular with a proximal emphasis. Laterally, one surface is prismatic and the other truncated. Chipping is a fine, longitudinal percussion scar dorsally and a single scar ventrally.

Basal junction: Acute or right angled.

Proximal end (base): One is straight and the other convex; both serve as the striking platform.

Area of use-wear: The retouched tip.

Relationships

Temporal and *Spatial:* Both of our samples occurred on the Paleo-Indian level and this period seems generally true for the Southwest (Haury 1950).

TYPE: CRUDE BLADE

Sources of Drawings: Left, North Mesa, zone D; right, Todsen Cave, surface

(*drawings = ½ natural size)*

Sample

Excavation	101
Surface	8
Pictorial	10
Total	**119**

Description (based on a sample of 30)

Dimensions (in mm)

	Mean	Range
Maximum length	40.20	32.0-50.0
Maximum width	19.60	12.0-28.0
Maximum thickness	6.60	4.00-11.0
Distal to maximum body width	15.60	0-24.0
Distal to maximum thickness	20.20	0-32.0
Minimum thickness	3.40	1.00-7.50
Distal to minimum thickness	22.60	0-37.0
Minimum width	11.60	5.00-25.0
Distal to minimum width	7.42	0-31.0

Form and Chipping Technique

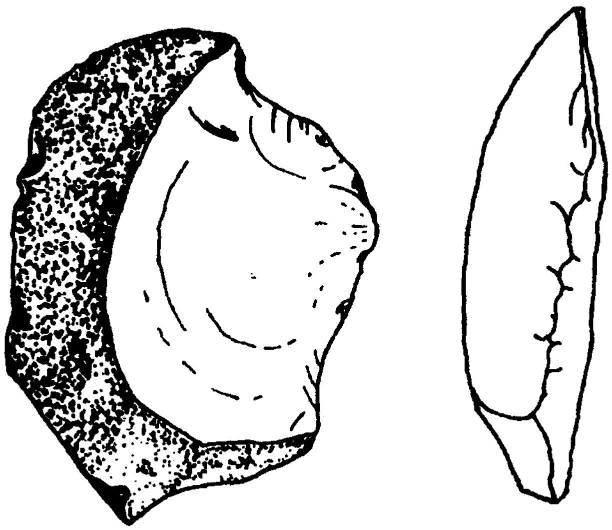
In the main these crude blades are elongate unifaces, prismatic or truncated in cross-section Most have flakes (at least two) that roughly parallel their long axis. One end, usually the distal, is the striking platform, either prepared or unprepared, and is opposite the convex to pointed feathered end (usually the proximal end). Whether they are struck from conical cores with fluted sides, the so-called prepared polyhedral cores, is difficult to determine, but we suspect so, even though these blades are very numerous.

Relationships

T*emporal* and *Spatial:* In our sequence these crude blades seem most popular in paleo-Indian and Early Archaic levels. Elsewhere in the Southwest they have been noted as occurring with Clovis points (Haury, Sayles and Wasley 1959) and other paleo-Indian assemblages (Haury 1950). Unfortunately, they have not been noted for the Archaic in the rest of the Southwest, although our data suggest they should occur.

TYPE: LARGE CONVEX UNIFACE

Source of
Drawings: Todsen Cave, zone K



(drawings = ½ natural size)

Sample

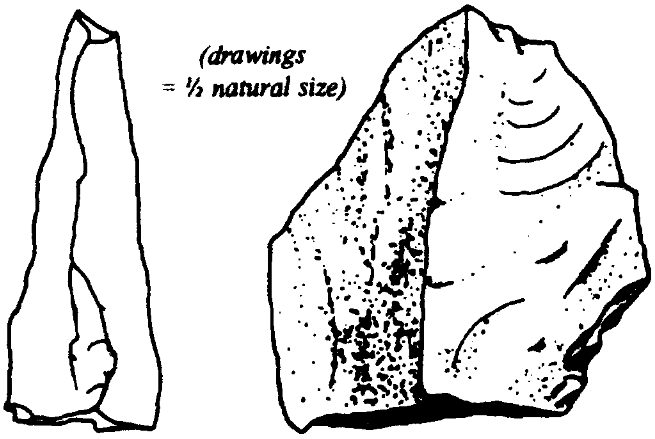
Excavation	97
Surface	3
Pictorial	10
Total	**110**

Description (based on a sample of 20)

Dimensions (in mm)

	Mean	Range
Maximum length	62.20	34.0-102
Maximum width	58.60	40.0-96
Maximum thickness	21.40	12.0-40
Distal to maximum body width	42.80	30.0-69
Distal to maximum thickness	47.60	25.0-102
Minimum thickness	7.60	4.0-12

	Mean	Range
Distal to minimum thickness	30.00	9.0-77.0
Minimum width	28.60	7.0-48.0
Distal to minimum width	13.00	0-43.0



(drawings = ½ natural size)

Form and Chipping Technique

Distal end (tip): The distal end comes in every conceivable form, but a popular form of the right edge seems to be concave (30%) or convex (2%), while the left edge is just the opposite. Chipping, when it occurs, for the most part is crude percussion on the dorsal right and left (80%), but a small percentage have crude percussion and fine percussion (10%).

Body edge: Usually one edge, if not both, is slightly convex (40%) to deeply convex (25%). Also, the edges usually are converging (70%), but the opposite edge on a few specimens (30%) can be straight (50%), sinuous (30%), or even concave (20%). Chipping occurs on the dorsal right and left on the converging convex edge (80%) or convex edges (20%); it is usually crude pressure at a not very steep angle, while the opposite side may have none (60%) or crude percussion (40%).

Body surface: Form in the distal-to-proximal cross-section most often is plano-convex (40%), but all other possibilities occur, while the left-to-right cross-section mainly is prismatic or plano-convex, but again all other possibilities exist. Chipping dorsally is mainly crude percussion; ventrally, it is a single scar.

Basal junction: Form on the right is obtuse angled (60%) or right angle rounded (40%), but again, there is much variation. The left mainly is right angle rounded (50%); obtuse angled (30%) and rounded (20%) are less popular.

Proximal end (base): Form shows every possible variation, but convex (20%), straight (20%), and sinuous (20%) are most popular. Chipping dorsally, when it exists (70%), mainly is crude percussion (50%).

Area of use-wear: Usually the convex edge left (40%), right (30%), or both (20%); a few have, in addition to the lateral edge retouch, retouch on the proximal or distal end (10%).

Relationships

Temporal: As Table IV-6 indicates, large convex unifaces are a major type, being dominant in Early and Middle Archaic times, but noticeably diminishing in ceramic times.

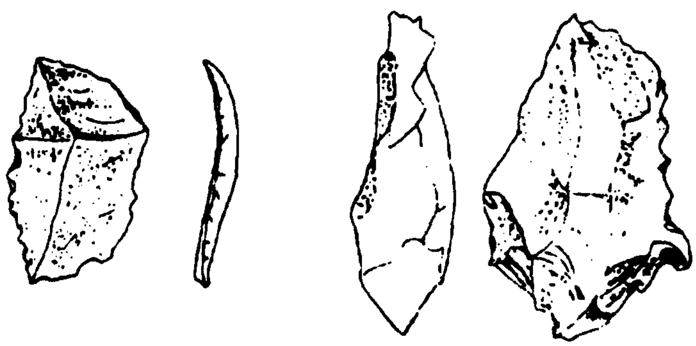
Spatial: Distribution is difficult to determine, but these unifaces seem to occur in Oshara (Morris and Burgh 1954) and Cochise (Dick 1965, figures 29-31; Martin et al. 1952) and are all over the Southwest at all times.

TYPE: LARGE DENTICULATE (SAW?)

Sources of Drawings: Todsen Cave: left, zone K; right, zone πJ

Sample

Excavation	42
Surface	3
Pictorial	4
Total	**49**



(drawings = ½ natural size)

Description (based on a sample of 5)

Dimensions (in mm)

	Mean	Range
Maximum length	87.2	51.0-116.0
Maximum width	98.6	31.0-62.0
Maximum thickness	23.3	6.50-37.0
Distal to maximum body width	41.0	18.0-70.0
Distal to maximum thickness	21.6	16.0-80.0
Minimum thickness	10.4	3.60-23.0
Distal to minimum thickness	35.3	9.00-65.0
Minimum width	28.6	11.0-50.0
Distal to minimum width	29.0	8.00-76.0

Form and Chipping Technique

Generally these (70%) are ovoid in outline and plano-convex in cross-section laterally and longitudinally, but a few are plano-plano (20%), plano-concave (5%), or plano-triangular (5%).

Distal end (tip): The left part of the end usually is crude percussion chipped and pointed acute straight or convex; the right side of the end is oblique pointed, but may be acute, convex, or concave.

Body edge: One edge (80%)–rarely both–deeply notched by percussion blows that form denticulates. Often the denticulated side is parallel to the main axis on the right or left side, but it may be contracting (10%) or converging, while the opposite unworked edge may be straight, parallel, converging convex, or converging straight.

Body surface: The ventral side usually is a single flake (making these unifacial), while the dorsal side bears crude percussion flakes.

Basal junction: Often right angle rounded both right and left, but some may be obtuse rounded and right angled (30%).

Proximal end (base): Usually crude percussion chipped and roughly straight (40%), but may be notched, sinuous-Z, or convex.

Relationships

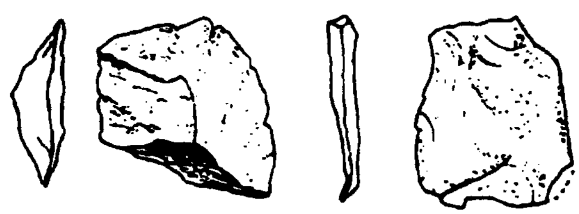
Temporal: Large denticulates occur mainly in the Early Archaic–Gardner Springs (12% to 18%) and Keystone (15.9%)–but might have first appeared in Paleo-Indian times (before 6000 B.C.); if so, they were rare. In the Middle and Late Archaic they diminish to less than 8% of the total side scrapers and occur even less frequently in ceramic times. Whether this indicates an early woodworking emphasis or whether these tools were used on leafy fibrous plants must await better use-wear studies; we suspect it was the latter on the basis of finds at Hinds Cave in the Big Bend region of Texas (Schaefer 1986).

Spatial: Denticulates have not been noted for the Cochise or Ventana Cave regions (Haury 1950), nor do they seem prominent in the Late Archaic of the Oshara tradition, although some may occur in Jay times (Irwin-Williams 1979). Our best evidence for their occurrence in this time period comes from east Texas in the Big Bend region (Shafer 1986). Denticulates seen to have been important in the Devil and Pandale period of the Middle Archaic of Texas (Turner and Hester 1985).

TYPE: SMALL CONVEX UNIFACE

Source of
Drawings: Todsen Cave, zone πJ

(drawings = ½ natural size)



Sample

Excavation	86
Surface	5
Pictorial	10
Total	**101**

Description (based on a sample of 6)

Dimensions (in mm)

	Mean	**Range**
Maximum length	33.00	15.0-40.0
Maximum width	32.25	24.0-45.0
Maximum thickness	6.75	4.00-14.0
Distal to maximum body width	26.00	18.0-32.0
Distal to maximum thickness	17.00	2.00-33.0
Minimum thickness	2.75	1.00-6.00
Distal to minimum thickness	20.75	8.00-31.0
Minimum width	25.00	10.0-32.0
Distal to minimum width	10.00	2.00-29.0

Form and Chipping Technique

Distal end (tip): Form varies considerably. Right sides of ends range from convex to concave, while left ones predominantly are straight, convex, and concave. Chipping on the dorsal right and dorsal left, when it occurs (40%), is usually crude percussion.

Body edge: Form shows one edge converging convex and retouched; occasionally both edges are retouched, but the edge opposite the retouch varies from concave to straight and may be sinuous.

Body surface: Distal-to-proximal cross-section is often plano-convex (30%), but all forms exist. Left-to-right cross-section is plano-plano (20%), truncated (20%), and plano-convex (20%), but all forms occur. Chipping dorsally usually is crude percussion; ventrally it is a single scar.

Basal junction: Form on the right and left is usually acute rounded or right angled, but all forms occur.

Proximal end (base): Form is varied, but deeply convex (25%) and straight (25%) are most popular. Chipping dorsally is usually crude percussion.

Area of use-wear: Usually lateral edges (left 40%, right 30%) or both (15%).

Relationships

Temporal: Small convex unifaces occur throughout the sequence in minor amounts, but they seem to increase during ceramic times.

Spatial: Distribution could not be determined, but they probably occur everywhere (Haury 1950).

TYPE: LARGE CONCAVE UNIFACE

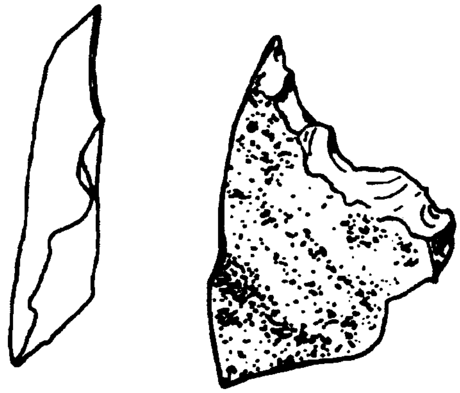
Source of
Drawings: Todsen Cave, zone πJ (see next page)

Sample

Excavation	68
Surface	1
Pictorial	10
Total	**79**

LARGE CONCAVE UNIFACE

(drawings = ½ natural size)



Description (based on a sample of 5)

Dimensions (in mm)

	Mean	Range
Maximum length	64.20	40.0-93.0
Maximum width	50.20	36.0-126.0
Maximum thickness	20.00	10 0-36.0
Distal to maximum body width	55.40	40.0-68.0
Distal to maximum thickness	50.20	11.0-68.0
Minimum thickness	8.20	4.0-14.0
Distal to minimum thickness	26.80	17.0-44.0
Minimum width	34.60	8.0-101.0
Distal to minimum width	10.60	0-37.0

Form and Chipping Technique

Distal end (tip): Varies considerably in form, but the right edges are often straight (25%), or acute parallel (15%) while the left distal edges are often convex (30%). Chipping on the dorsal right is either crude pressure or percussion, while the dorsal left, when it exists (40%), is crude percussion.

Body edges: Usually include one that is straight or concave with dorsal crude pressure chipping, while the opposite side can vary from sinuous to convex, straight, or concave, and usually bears crude percussion flaking. Fewer than 15% have both converging concave edges with pressure flaking; about 5% are sp. eshavelike, with wide, deep-notched edges and pressure retouch.

Body surface: Form of the distal-to-proximal cross section is often plano-convex (30%), but all forms occur; left-to-right cross-section more often is truncated (20%) , but plano-convex (10%) and plano-plano (10%) occur, as do all other forms. Chipping on the dorsal surface is crude percussion, while the ventral surface is a single scar.

Basal junction: Varies considerably, but since edges mainly are converging (60%), the form right and left mainly is acute rounded or angled.

Proximal end (base): Form is often convex (45%), straight (20%), or deeply convex (15%) , but other forms also occur. Chipping dorsally usually is crude percussion.

Area of use-wear: Mainly lateral left (40%), or right (40%), and only (15%) on both edges.

Relationships

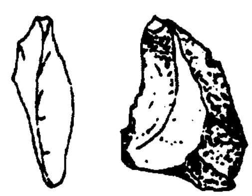
Temporal: Although large concave bifaces seem to occur in Early Archaic times, and perhaps even before then, they do not become important until Late Archaic and early ceramic times. One or two in every horizon are spokeshavelike objects, a form that seems to be a minor variant of the type, although all could have been used in this manner.

Spatial: Distribution could not be determined, although they may occur throughout the rest of the Southwest.

TYPE: SMALL CONCAVE UNIFACE

Source of
Drawings: Todsen Cave, zone J

(drawings = ½ natural size)



Sample

Excavation	20
Surface	0
Pictorial	5
Total	**25**

Description (based on a sample of 3)

Dimensions (in mm)

	Mean	Range
Maximum length	28.2	18.0-38.0
Maximum width	25.0	20.0-33.0
Maximum thickness	7.2	3.0-12.0
Distal to maximum body width	24.4	18.0-33.0
Distal to maximum thickness	18.6	6.0-28.0
Minimum thickness	2.4	1.0-4.0
Distal to minimum thickness	16.4	14.0-25.0
Minimum width	10.0	4.0-18.0
Distal to minimum width	3.6	0-8.0

Form and Chipping Technique

Distal end (tip): This uniface has a tendency to be acute pointed with straight or convex edges. Chipping, both distal right and distal left, is about half crude percussion and half crude pressure.

Body edge: One body edge is usually concave, on the right (35%), on the left (50%), and on both (15%). Chipping on the concave side is usually fine percussion or crude pressure; about 20% are notched so they are like small spokeshaves.

Body surface: The form of the distal-to-proximal cross-section is often plano-convex, triangular with a proximal emphasis, or plano-plano, but other forms occur. The left-to-right cross-section is truncated (20%), but other forms occur. Chipping on the dorsal surface is crude percussion, while on the ventral surface it is a single scar.

Basal junction: Usually acute, since these unifaces are often trianguloid in outline, with about half angled and the remainder rounded.

Proximal end (base): Varies from straight to convex and often (33%) serves as the striking platform.

Area of use-wear: Both right and left edges (50%), with some both (15%); a fairly high proportion are notched rather than shallowly concave (20%).

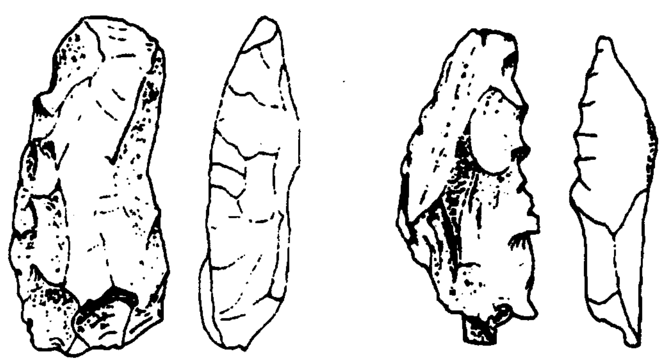
Relationships

Temporal and *Spatial:* Small concave unifaces are a minority type throughout the Jornada sequence, and the same may be true for the rest of the Southwest.

TYPE: BACK-BLUNTED SIDE BLADE

Sources of Drawings: Todsen Cave: left, zone K; right, zone J

(drawings = ½ natural size)



Sample

Excavation	12
Surface	4
Pictorial	2
Total	**18**

Description (based on a sample of 4)

Dimensions (in mm)

	Mean	Range
Maximum length	76.75	66.0-93.0
Maximum width	34.75	31.0-42.0
Maximum thickness	18.75	17.0-21.0
Distal to maximum body width	40.00	22.0-54.0
Distal to maximum thickness	34.00	28.0-44.0
Minimum thickness	6.50	4.0-10.0
Distal to minimum thickness	11.25	4.0-31.0
Minimum width	15.00	5.0-26.0
Distal to minimum width	8.50	5.0-15.0

Form and Chipping Technique

Generally, the back-blunted side blades are more or less crescent shaped and almost always steeply plano-convex laterally, but they vary longitudinally from plano-convex (50%) to plano-rectangular (50%).

Distal end (tip): Distal ends with crude pressure flaking are convex (50%), but a few are straight (25%) and some are pointed acute or oblique.

Body edge: Usually the left edges are convex (80%), parallel to the main axis and back-blunted by steep percussion flaking. The right edges are not so steep and pressure retouched, often are concave (40%); either parallel, converging, or straight parallel (40%); and one is convex parallel.

Body surface: All back-blunted side blades are unifacial, with crude percussion on the deeply convex body surface.

Basal junction: Many connect to the base with a right angle rounded right or left, but some basal junctions are rounded obtuse (30%), acute angled (20%), or obtuse angled (10%).

Proximal end (base): The proximal end, often just slightly wider than the distal, also has crude pressure flaking on either slightly convex or straight ends.

Area of use-wear: The lateral edge opposite the convex blunted side

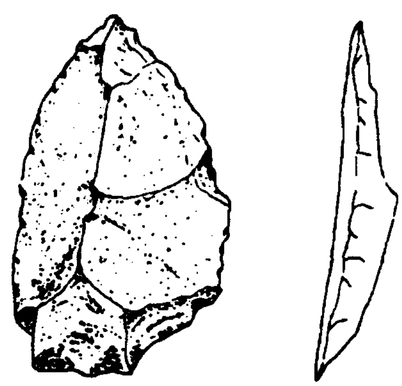
Relationships

Temporal and *Spatial:* Back-blunted side blades seem to be important mainly in the Middle Archaic, particularly the Keystone phase, in our excavated levels. Their distribution in the rest of the Southwest could not be determined, but one example seems to occur at Bat Cave (Dick 1965, figure 35).

TYPE: LARGE POINTED UNIFACE

Source of
Drawings: Todsen Cave, zone D

(drawings = ½ natural size)



Sample

Excavation	16
Surface	2
Pictorial	3
Total	**21**

Description (based on sample of 3)

Dimensions (in mm)

	Mean	**Range**
Maximum length	53.75	36.0-84.0
Maximum width	30.50	24.0-48.0
Maximum thickness	11.25	7.0-18.0
Distal to maximum body width	45.75	27.0-62.0
Distal to maximum thickness	35.25	31.0-42.0
Minimum thickness	4.00	2.0-8.0
Distal to minimum thickness	30.50	5.0-53.0
Minimum width	12.00	5.0-24.0
Distal to minimum width	22.50	0-78.0

Form and Chipping Technique

Distal end (tip): As their name indicates, these unifaces usually are acute pointed with straight edges, but sometimes they are convex both right and left (20%). Chipping on the dorsal right and left usually is crude percussion, but on some (40%) it is crude pressure on one side–right (15%), left (15%), both (10%).

Body edge: Usually converging in form. On the right it may range from concave to convex, while the left is much the same. Chipping on the dorsal right and dorsal left is mainly crude percussion (66%), but some crude pressure occurs.

Body surface: Form of the distal-to-proximal cross-section is often trianguloid with a proximal emphasis (50%), but other forms occur. The left-to-right cross-section is often plano-convex (50%), but may be truncated (20%), prismatic (20%), or some other form. Chipping on the dorsal surface is always crude percussion, while ventrally it is a single scar.

Basal junction: Usually acute angled (since they are more or less triangular in form) and may be rounded or sharp.

Proximal end (base): Often convex (40%) or straight (40%), but other forms occur. Chipping on the dorsal is usually crude percussion and sometimes serves as the striking platform (20%).

Area of use-wear: The tip, usually on both sides (50%), but occasionally on only one.

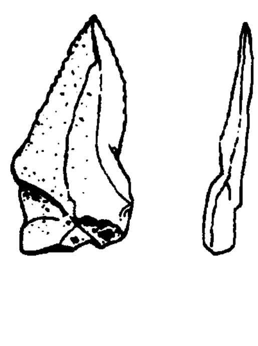
Relationships

Temporal and *Spatial:* Large pointed unifaces seem to start in Middle Archaic times and last into ceramic times in the Jornada region. They may have a similar distribution in the rest of the Southwest (Haury 1950; Dick 1965, figure 35; Irwin-Williams 1979; Martin et al. 1952).

TYPE: SMALL POINTED UNIFACE

Source of
Drawings: Todsen Cave, zone πJ

(drawings = ½ natural size)



Sample

Excavation	10
Surface	1
Pictorial	1
Total	**12**

Description (based on a sample of 3)

Dimensions (in mm)

	Mean	**Range**
Maximum length	31.00	20.0-35.0
Maximum width	21.33	19.0-24.0
Maximum thickness	6.00	3.0-8.0
Distal to maximum body width	27.33	20.0-35.0
Distal to maximum thickness	15.33	5.0-35.0
Minimum thickness	2.00	1.0-4.0
Distal to minimum thickness	17.66	12.0-25.0
Minimum width	6.33	2.0-12.0
Distal to minimum width	1.66	1.0-4.0

Form and Chipping Technique

Distal end (tip): Since small pointed unifaces are mainly trianguloid in form, they are often pointed acute and straight, both right and left. Chipping on the dorsal right and left is usually fine percussion or crude pressure.

Body edge: Always converging; the form of right and left is often straight (66%), but may be convex (17%) and rarely concave (8%) or sinuous (8%). Chipping on the dorsal right and left is often crude pressure (80%), but fine and crude percussion also occur.

Body surface: Form of the distal-to-proximal cross-section often is triangular with either a distal (67%) or proximal emphasis (33%), while the left-to-right cross-section is often plano-plano or truncated. Chipping dorsally and ventrally is crude percussion.

Basal junction: Usually acute, either rounded or sharp right and left.

Proximal end (base): Form is often convex to straight. Chipping on the dorsal is usually crude percussion, and on some (33%) this serves as the striking platform.

Area of use-wear: Always the tip; some seem like gravers or drills, but others may have been unifacial projectile points.

Relationships

Temporal and *Spatial:* Small pointed unifaces may start in the Late Archaic, but most are of ceramic times. Their temporal range suggests they might be crude arrowpoints or tips; one unifacial fragment from Chavez Cave was attached to an arrow shaft. Whether they occur in other parts of the Southwest could not be determined, but we suspect they do.

Section 5

Ground and Pecked Stone Tools

Our ground and pecked stone tools, like the various chipped stone tools, could be divided into types that showed change throughout the levels of Todsen Cave. Those types had clusters of attributes that had significance temporally and spatially. Although the attributes differed greatly from those for chipped stone, the same general categories–form, dimensions, and manufacturing technique and/or use-wear–still applied. The last category in part reflects the kind of seeds, plants, or objects being ground, but we never could determine exactiy which was ground, although we experimented with some varieties and saved soils found inside mortars, milling stones, and metates for analysis. Here is a realm for further study.

We found the ground stone tools divided into two main categories–the grinders (handstones or peckers) and the grindees (nether stones or peckees), often miscalled manos and metates in the Southwest. We used the same kind of attributes and terminology for both categories. The most convex surface still was the dorsal side; the less convex, which was often concave because of use, was considered the ventral surface, and the junction of the two the side or edge. We considered the longer, parallel portion the lateral edges and the shortest side the distal end, opposite which was the proximal end or base. However, we had difficulty with these terms because many of our objects were round or square in outline. In such cases, we used the back-and-forth direction of the grinding pattern as the indicator of proximal-to-distal directions, with the greatest wear being on the proximal end.

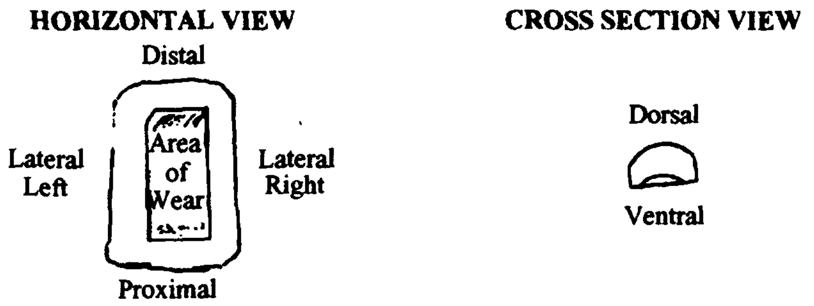


Figure IV-30. Orientation of Ground/Pecked Stone

We divided the attributes of form into two categories, horizontal and cross section. We kept the horizontal terms as general as possible.

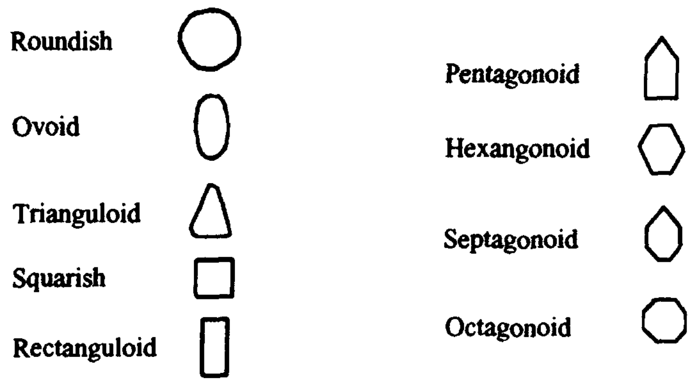


Figure IV-31. Ground/Pecked Stone Form Attributes–Horizontal View

For cross-section attributes we looked at the proximal-distal view and the lateral form at midpoint.

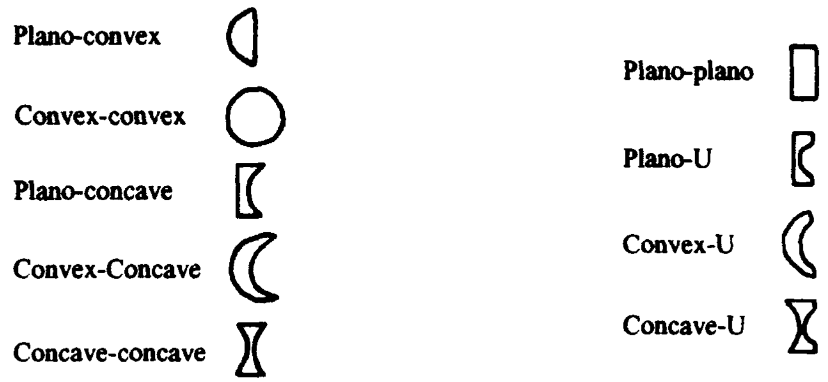


Figure IV-32. Ground/Pecked Stone Form Attributes–Cross-Section View: Proximal-Distal

Figure IV-33. Ground/Pecked Stone Form Attributes–Cross-Section View: Lateral at Midpoint

We used two types of dimensions–general form and the areas of use that were worn or ground and/or pecked. For the latter, the dorsal and ventral measurements were the same (see figures IV-34 and IV-35).

The manufacturing technique and/or use-wear attributes were determined by the pattern of scratches or peck marks (see figures IV-36 and IV-37).

The final category, polish, was somewhat like that for motion (see Figure IV-38).

We recorded the attributes on 3"x5" cards and compared the cards to determine attribute clusters (see Figure IV-39).

It immediately became apparent we had two main categories–(1) hand-held stones, such as manos, mullers, pestles, hammers, and the like; and (2) objects used as receptacles, such as anvils, metates, milling stones, mortars, and the like.

Hand stones (87) were slightly more numerous than receptacle stones (76). Patterns of use-wear divided our hand stones into those that had been ground or rubbed against the receptacles, making scratches or polish on their surfaces; and those that had been pounded up and down against the receptacle, leaving peck marks on the surface. We further divided the latter category into pebble hammerstones and cobble pestles, but it often was difficult to tell them apart. (Although other types of pestles occur in Ceramic times in the Southwest, we found none in our excavations and therefore did not include them.)

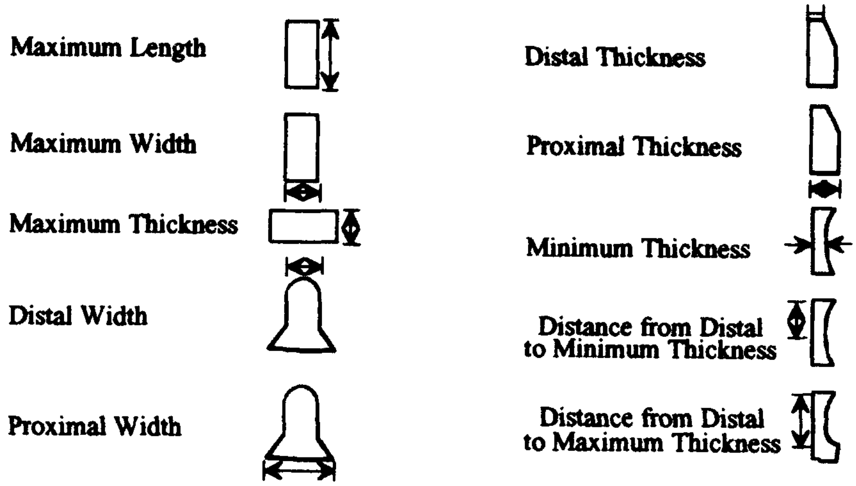


Figure IV-34. Dimensions of Ground/Pecked Stone–Overall Form

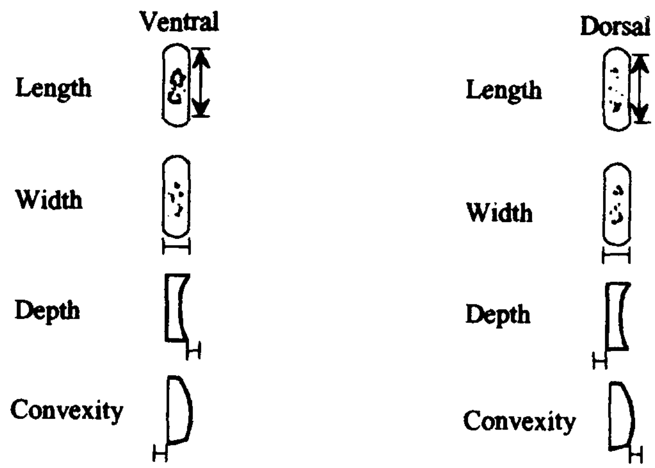


Figure IV-35. Dimensions of Ground/Pecked Stone–Worn Area

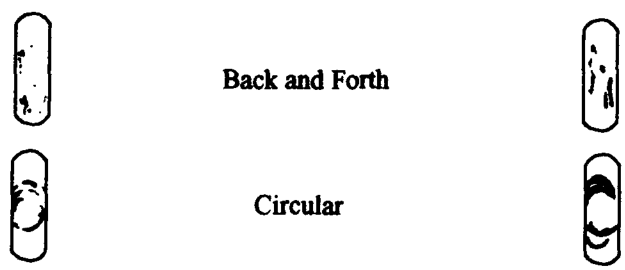


Figure IV-36. Manufacture or Use-Wear Attributes on
Ground/Pecked Stone–Pattern of Motion

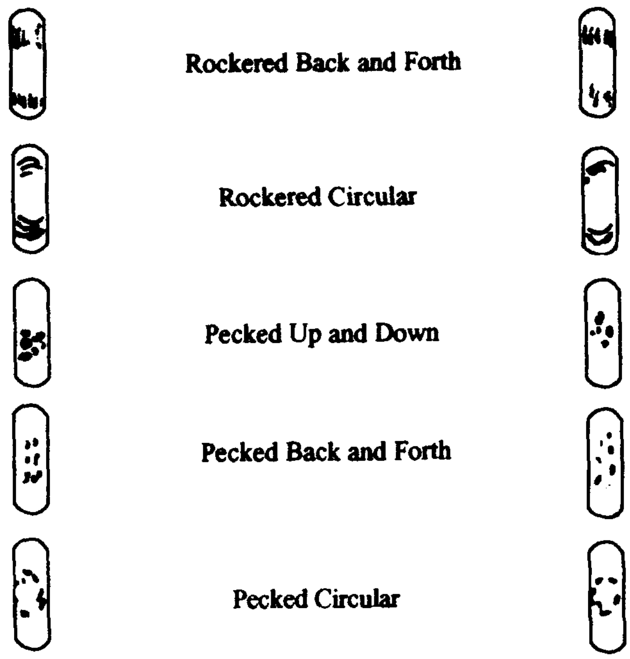


Figure IV-36. continued

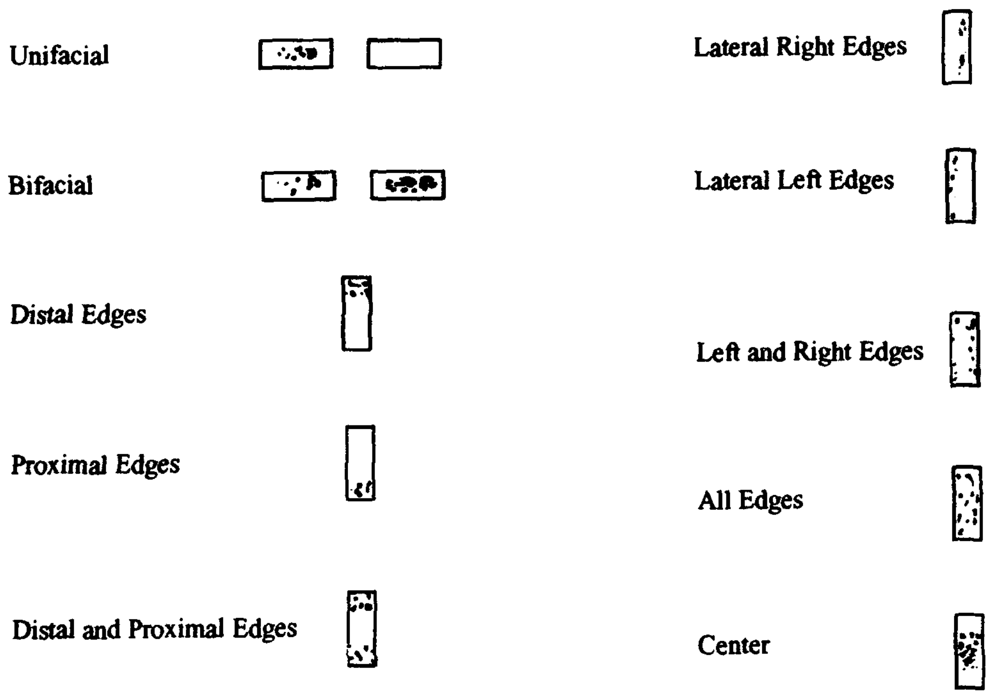


Figure IV-37. Area of Use-Wear or Manufacture on Ground/Pecked Stone

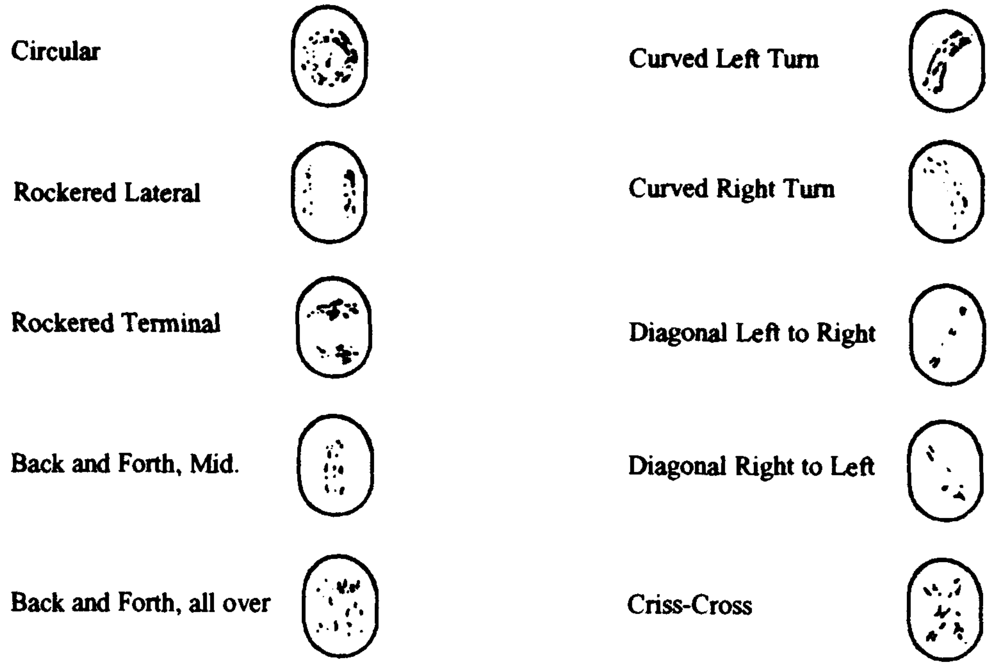


Figure IV-38. Area of Polish on Ground/Pecked Stone

We drew upon our experience in Tehuacán, Mexico, where modern usage–ethnographic analogy par excellence–indicated two important categories of grinding stones. Some hand stones were used in a round-and-round motion, used mainly to grind relatively flat seeds (often of wild plants) into coarse flour. A second hand stone was used in a back-and-forth motion, often used to grind roundish seeds, such as corn kernels, into fine flour that could be made into dough. The former group included pebble mullers, disk mullers, and polishing pebbles; the latter were manos that were subdivided into more types on the basis of other features. For example, wedge and ovoid rockered manos were used in a rocking back-and-forth motion on a metate, while the others were used in a back-and-forth motion in which the hand stone moved parallel to the surface of the receptacle or metate. One group had narrow, more pointed worked surfaces and was identified as abraders. The series of mano types included one-handed pebble manos and small rectangular manos, two-handed long rectangular and long prismatic wedge types that were heavy enough to mash hard, dried corn kernels or make soft, soaked corn kernels into a fine flour paste that would stick together when cooked as bread or tortillas.

These different groups were great time markers and indirectly reflected changes in food preparation as well as subsistence practices. As might be expected, the hammerstones appeared early, possibly in Paleo-Indian times, and lasted throughout the sequence. They probably were used not only on hard seeds (acorns, nuts, and the like), but also on stone, bone, wood, etc. Much later, in the Late Archaic (Hueco phase), cobble pestles, often used in nonmovable mortar holes, took over the function of this all-purpose hand tool, lasting into Ceramic times. Mullers also appeared early in the Archaic and diminished in importance by Early Ceramic times. Our three types of ground or pecked stone thus have different temporal positions. Pebble mullers start in the Archaic, disk mullers are mainly Middle Archaic, while polishing pebbles (perhaps not used on food) appeared in Ceramic times.

Manos also reflected a fine sequence. Elongated pebble manos appeared in early Middle Archaic times; rocker manos began in late Middle Archaic times, and the wedge variety lasted into Early Ceramic times. Next came small rectangular manos in Late Archaic times, followed by large manos (for corn) in Ceramic times. The wedge or prismatic two-handed manos appeared later than the large rectangular type, which might start in Hueco times. In the following descriptions we have separated our hand stones from our receptacle stones. Although they obviously are connected and show similar temporal significance, there is no real one-to-one correlation between any of the two groups.

FORM

Horizontal view ___

Cross section prox.-dist. ___

Cross section mid. rt-lt. ___

DIMENSIONS		Ventral use	Dorsal use
Overall			
Max. length	___	___	___
Max. wd.	___	___	___
Max. thk.	___	depth ___	___
Distal wd.	___		
Prox. wd.	___	convexity	
Distal thk.	___	___	
Prox. thk.	___		___
Min. thk.	___		
Dist. to min. thk.	___		
Dist. to max. thk.	___		

WEAR/MANUFACTURING TECHNIQUES

Polish

Motion

Area of Use

1.

2.

Site

Square

Level

Zone

Culture

Catalogue

Date

Type

Figure IV-39. Cards for Recording Attributes of Ground/Pecked Stone

Perhaps the best correlation is between our pebble hammerstones and our anvil-mortars that are prominent throughout the Archaic and last into Ceramic times. Milling stones and mullers also start in the Early Archaic and diminish in later times, but we could not connect a particular muller type with a definite milling stone type with any degree of accuracy. In a vague way our slab metates and pebble manos and our rockered manos and metates seem to be roughly contemporaneous and connected, but we found it hard to correlate our boulder metates with any type of hand stone. These metates could connect with our small rectangular manos, but the bifacial slab metates have a more similar distribution. Perhaps the best fit is the tools connected with the grinding of corn–trough metates and long rectangular manos, as well as Mexican metates and large prismatic manos.

In terms of other tools, the sinew stone and abrader might be connected, but the latter also could connect with our paint palettes, while the disks are completely separate and unconnected.

Our ground stone tools obviously connected with the preparation of various types of foodstuffs. Ethnographic analogy and preserved plant remains give us some hints of the type of foods for which they were used. Pestles, hammerstones, anvil-mortars, and mortar (holes) seem connected with pounding certain kinds of hard seeds and nuts into edible foods, a practice that occurs throughout the Archaic–perhaps even seasonally. The mullers and milling stones may be involved in grinding disk-shaped seeds, such as mesquite seeds, grass seeds, and others, into coarse flour; our manos and metates that have evidence of a rockered motion also could have been used in this way in Middle

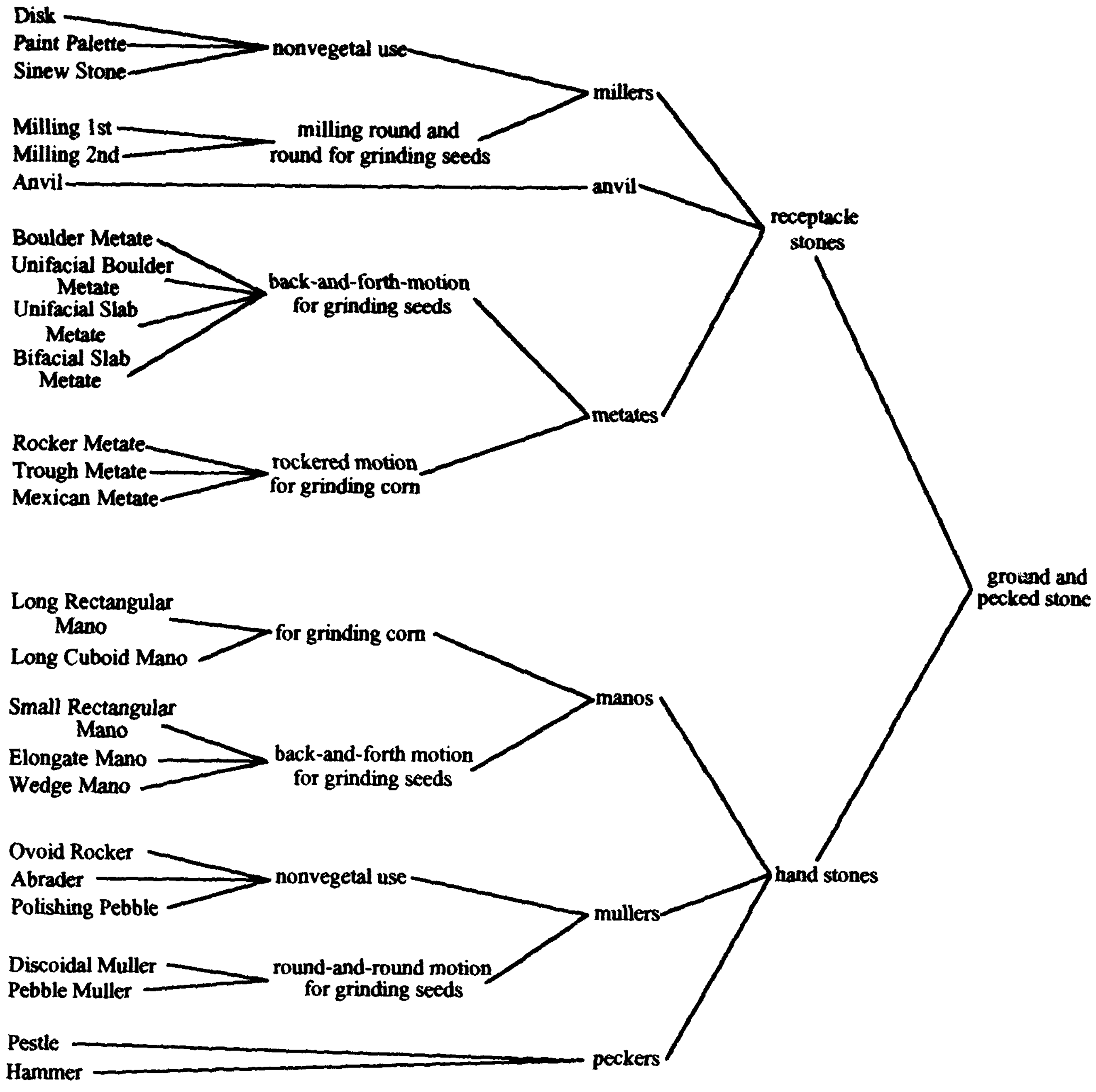


Figure IV-40. Cluster Analysis of Ground/Pecked Stone Types

Archaic times. However, these rockered tools also could have been used on small, hard, round seeds, such as opuntia and other cactus seeds and amaranth seeds--but the small rectangular manos and boulder metates also could have been used on these seeds.

This brings us to the problem of corn. Corn certainly was ground to fine flour with our long, heavy manos, probably in trough or Mexican metates, but corn came into our sequence in Fresnal times, before those tools arrived, and was important in Hueco times when those tool types were relatively rare. Was corn not ground at that time, or was it ground into coarse flour with the lighter manos in boulder metates? These questions, like many more about our ground stones, are unanswered and remain a field for future studies.

Table IV-7. Correlation of Ground Stone Types with Components in the Jornada Region

	Hammerstone	Pebble Muller	Boulder Anvil-milling Stone	Boulder Bifacial Milling Stone	Boulder Unifacial Milling Stone	Discoidal Muller	Slab Unifacial Metate	Sinew Stone	Boulder Rockered Metate	Boulder Bifacial Metate	One-handed Rectangular Mano	Ovoid Rockered Mano	Wedge Rockered Mano	Cobble Pestle	Slab Bifacial Metate	Trough Metate	Slab Paint Palette	Two-handed Rectangular Mano	Boulder Unifacial Metate	Two-handed Prismatic Mano	Footed Mexican Metate	Elongate Pebble Abrader	Small Polishing Pebble	Ground Stone Sun Disk	TOTAL
TOTAL	33	23	17	4	11	7	12	11	5	4	15	3	8	3	5	11	19	10	5	5	8	3	2	1	225
LA5529, surface	1			2	2	1					1					2				1	2				
LA5531, surface										1						1	2			1					
LA5529, Zone A	4	2														1					2				
LA5531, Zone A																1						1			
LA5531, Zone D	2										1			2	1		2	1		1	1			1	
LA5531, Zone D1	1																								
LA5531, Zone F+	4	2				1		1	1		5		2		2	3	4	1			1	2	1		
LA5531, Zone D2	1																3								
LA5529, Zones A-B											1			1				1		1	1	1			
LA5529, Feature 7		3					1			1	1			1		1	1	6	5	1					
LA5529, Zone upper B							1									1	6				1				
LA5529, Feature 3																		1							
LA5531, Zone πJ	1	2	1				3	4		1	2		4	1	2	1	1								
LA5529, Zone middle B											2	1	2												
LA5531, Zone F								1				1													
LA5531, Zone J	3	3	3			3	2	5	2			1													
LA5529, Feature 2						1	1				2														
LA5531, Zone J1		1	1	1				1	1	1															
LA5529, Feature 6	2	2	2		5		1																		
LA5529, Zone lower B	1	1	2		1																				
LA5531, Zone K	3	1	5		3	1	3																		
LA5529, Feature 8		1																							
LA5529, Zone upper C	2	2			1																				
LA5531, Zone K1	1	1	3	1																					
LA5531, Zones M-N	1	1																							
LA5529, Zone lower C	1	2																							
LA5529, Zone E	1																								

Another field for study is the residue found in receptacles. We attempted residue and use-wear studies on some of these objects, but with little success. We also collected soils and caked residue from inside our mortars, milling stones, and metates, but the basic analysis has not been completed and much remains to be done to understand the contextual aspects of those tool types and thereby obtain a better understanding of ancient cultural activities connected with ground and pecked stone tools. On the following pages we describe first the hand-held stones, such as manos, mullers, pestles, and hammerstones. We next discuss the receptacle stones.

TYPE: PEBBLE HAMMERSTONE

Source of
Drawing: Todsen Cave, zone K

(drawing = ½ natural size)

Sample

Excavation	31
Surface	2
Pictorial	10
Total	**43**

Description (based on a sample of 6)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*		*Dorsal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	75.50	40.0-116.6	40.0	33.0-46.0		35.0-46.0
Maximum width	54.00	37.0-?	33.2	31.0-46.0		30.0-40.0
Maximum distal width	40.00	37.0-43.0				
Maximum proximal width	54.00	37.0-?				
Maximum thickness	43.00	30.0-55.0				
Maximum distal thickness	42.00	30.0-54.0				
Maximum proximal thickness	43.00	30.0-55.0				
Tip to maximum width	35.00	30.0-40.0				
Tip to maximum thickness	36.00	31.0-39.0				
Minimum thickness	30.45					
Tip to minimum thickness	6.00					

Form

Horizontal: Long oval to roundish.

Cross section: Distal to proximal–disk convex-convex. Left to right–convex-convex to round.

Wear

Polish: None.

Motion: Up and down.

Area of use-wear: Pecked on one or both ends.

Relationships

Temporal and *Spatial:* Pebble hammerstones occur throughout our sequence and are common everywhere.

TYPE: PEBBLE MULLER

Source of Drawing: Todsen Cave, zone J

(drawing = ½ natural size)

Sample

Excavation	23
Surface	2
Pictorial	10
Total	**35**

Description (based on 4 whole ones)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*	
	Mean	**Range**	**Mean**	**Range**
Maximum length	103.00	69.76-128.5	90.5	65.0-123.0
Maximum width	82.00		65.5	51.8-71.4
Maximum distal width	49.00	31.9-77.1		60.0±
Maximum proximal width	61.50	37.3-76.1		70.0±
Maximum thickness	38.00	8.0-63.0		
Maximum distal thickness	29.50	7.85-62.1		
Maximum proximal thickness	32.75	20.5-54.8		
Tip to maximum width	51.00	40.0-63.0	45.0	41.0-49.0
Tip to maximum thickness	49.00	41.0-58.0	44.0	37.0-51.0
Minimum thickness	7.85			
Tip to minimum thickness	6.50			

Form

Horizontal: Many are ovoid (40%), but almost all are roughly triangular (40%), and one is roundish while another is roughly quadrilateral.

Cross section: Distal to proximal–half, convex-convex; half, plano-convex. Left to right–more than half convex-convex; rest, plano-convex.

Wear

Polish: Most show high polish in the middle of the used area and along the edge in a curved area.

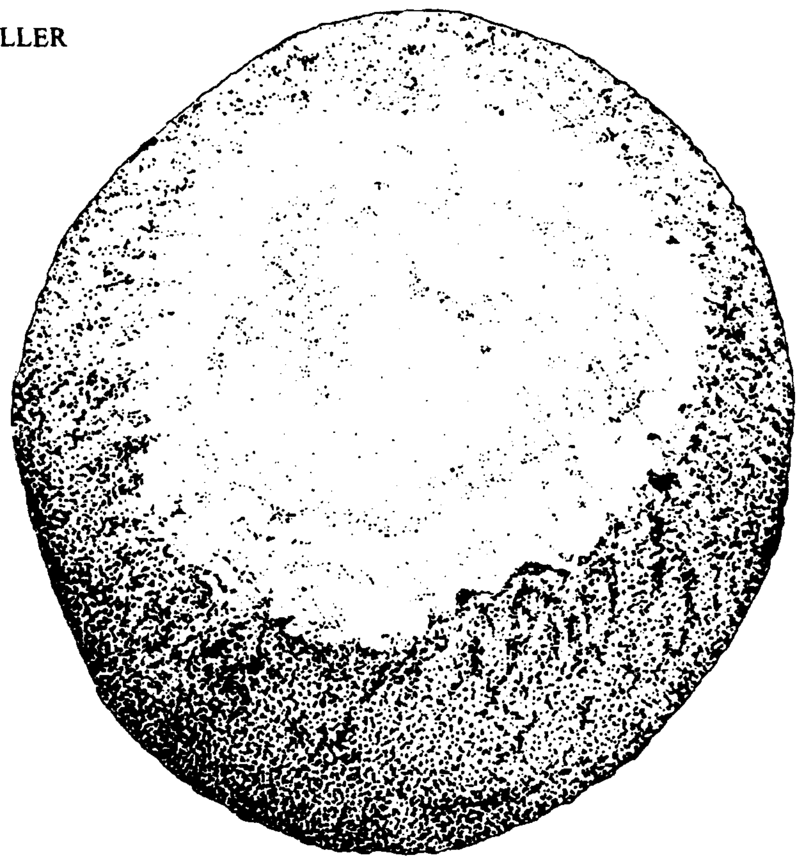
Motion: Round-and-round scratches, mainly on edges.

Area of use-wear: A selected flattened oval river pebble used only on one side.

Relationships

Temporal and *Spatial:* Pebble mullers appear early in our Jornada-Archaic sequence and last in diminishing amounts into Ceramic times. They seem to have a similar range in the Cochise development in Arizona (Waters 1986, figure 4.3; Sayles 1983, figures 9.3e-f; Haury 1950, figure 70) and the Mogollon Rim of New Mexico (Dick 1965, figure 39; Martin et al. 1952, figure 33). They also appear in Bajada times in the Colorado Plateau (Irwin and Irwin 1966, figure 77) and may have a similar range in the Oshara-Anasazi sequence (Parry and Christenson 1987; Kidder 1932, figure 47; Morris and Burgh 1954, figures 86q-r).

TYPE: OVOID-SHAPED (DISK-LIKE) MULLER



Source of
Drawing: Todsen Cave, zone KI

(drawing = ½ natural size)

Sample

Excavation	6
Surface	1
Pictorial	10
Total	**17**

Description (based on 3 whole ones)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*		*Dorsal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	120.6	108.0-134.0	89.6	75.0-100.8	94.6	83.0-101.0
Maximum width	95.0	75.0-126.0	74.6	55.0-82.0	82.0	80.0-86.0
Maximum distal width	81.0	67.0-90.0	64.0	57.0-73.0	62.0	58.0-70.0
Maximum proximal width	81.0	69.0-91.0	65.0	56.0-71.0	62.0	56.0-71.0
Maximum thickness	47.0	35.0-65.0				
Maximum distal thickness	43.0	28.0-65.0				
Maximum proximal thickness	43.0	35.0-53.0				
Minimum thickness	28.0	26.0-35.0				

Form

Horizontal: Most are oval (66%); a few are round (33%). The sides are mostly ground or pecked at a right angle to the surfaces (90%).

Cross section: Half are disk convex-convex; a few are disk plano-plano (37%), and one is convex-convex; in fact, one of its surfaces is more bevelled than convex, indicating a rockered motion.

Wear

Polish: Generally round and round on both surfaces; but with variation–two show high luster in the center; the rockered muller is polished along the median ridge-like axis.

Motion: Ventral–all ground round and round; dorsal–same except for one that may have been rockered.

Area of use-wear: All used bifacially. Mullers seem made of selected flat roundish river pebbles that had lateral edge worked (pecked) to give a disk shape.

Relationships

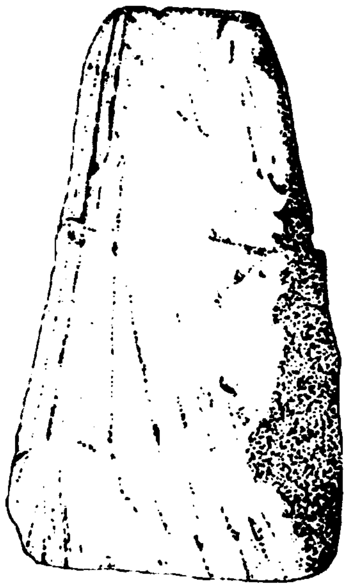
Temporal and *Spatial:* In Todsen Cave the majority of ovoid-shaped mullers were found in zone J, a Fresnal level. One such muller did occur in zone Kl, a Gardner Springs zone dating back to 6000-4000 B.C. This occurrence is in general agreement with the Mogollon Rim (Dick 1965, figures 39-40) and Gila region, where the mullers, called "ovoid cobble manos," appear with Chiricahua remains (Sayles 1983, figure 9.3). They also occur in the Oshara tradition in the Colorado Plateau (Morris and Burgh 1954, figures 86a-f), and their occurrence in the Deshe complex (Lindsay et al. 1968, figure 26a) suggests they are as early as in the Jornada region. In Ventana Cave, however, one disk "mano" worked on one side occurred in the volcanic debris of Folsom or Clovis times (Haury 1950, figures 70a-b). The mullers also seem to occur very early in Mohave Lake in California (Waters 1986, figure 4.3c), which suggests they may have spread into the Southwest from that direction at a very early time.

The mullers probably were often used in our boulder milling stones, and experiments suggest they were used to grind small, round seeds, such as grass seed, cactus seed, and amaranth, but were not very effective in grinding large, flat seeds, such as mesquite, corn, nuts, and berries.

TYPE: ELONGATE PEBBLE MANO

Source of
Drawing: Todsen Cave, zone πJ

(drawing = ½ natural size)



Sample

Excavation	26
Surface	3
Pictorial	10
Total	**39**

Description (based an a sample of 4 whole ones)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*		*Dorsal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	87.50	52.0-121.7	82.5	50.0-112.0	43.0	38.0-61.0
Maximum width	56.75	40.2-75.4	56.5	38.0-74.5	42.1	36.0-47.5
Maximum distal width	39.20	10.2-68.5	37.2	18.5-55.4		
Maximum proximal width	57.10	39.25-72.85	41.2	36.0-62.0		
Maximum thickness	34.25	16.8-52.0				
Maximum distal thickness	27.50	14.9-48.0				
Maximum proximal thickness	34.00	14.65-52.3				
Tip to maximum width	72.50	68.0-90.0				
Tip to maximum thickness	70.00	65.0-85.0				
Minimum thickness	14.90					
Tip to minimum thickness	6.80					

Form

Horizontal: Many are roughly trianguloid (66%), but some are ovoid (22%), and two possibly are rectangular (11%).

Cross Sectionion: Distal to proximal–most are plano-convex, but one is plano-plano. Left to right–all are plano-convex.

Wear

Polish: Occurs mainly in the center, parallel to the long axis, but occasionally on the edges.

Motion: Scratches are back and forth, mainly along the long axis, but on about half the samples wear also occurs on the narrow axis; the grinding thus parallels the surface. Only one sample might be rockered.

Area of use-wear: Only two are worked on both sides (11%); the majority are unifacial.

Relationships

Temporal and *Spatial:* In the Jornada region elongate pebble manos seem to start in Middle Archaic times and diminish in later horizons, being rare or absent in Ceramic times. In the Cochise sequence they seem to start in the Chiricahua (Sayles 1983), although there are claims that they were earlier (Waters 1985). I was unable to determine their distribution in the Oshara tradition to the north, but some manos from Black Mesa may be of this type (Parry and Christenson 1987:47).

TYPE: PEBBLE ROCKERED MANO

Source of

Drawing: Todsen Cave, zone πJ (see next page)

Sample

Excavation	4
Surface	1
Pictorial	6
Total	11

Description (based on a sample of 2 whole ones)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*	
	Mean	**Range**	**Mean**	**Range**
Maximum length	106.5	102.9-110.0	77.5	65.5-90.0
Maximum width	74.0	69.0-78.0	63.5	57.35-69.8
Maximum distal width	61.0	54.1-69.7	56.0	
Maximum proximal width	70.5	69.0-78.0	54.0	
Maximum thickness	54.5	48.0-63.0		
Maximum distal thickness	41.5	34.5-48.8		
Maximum proximal thickness	54.5			
Tip to maximum width	51.0	48.0-61.0	30.0	
Tip to maximum thickness	54.0	46.0-63.0	32.0	
Minimum thickness	34.5		34.0	
Tip to minimum thickness	6.0			

Form

Horizontal: Ovoid.

Cross section: Distal to proximal –plano-convex and convex-convex. Left-to-right–mainly convex-convex.

Wear

Polish: Parallel to one edge and rockered ridge.

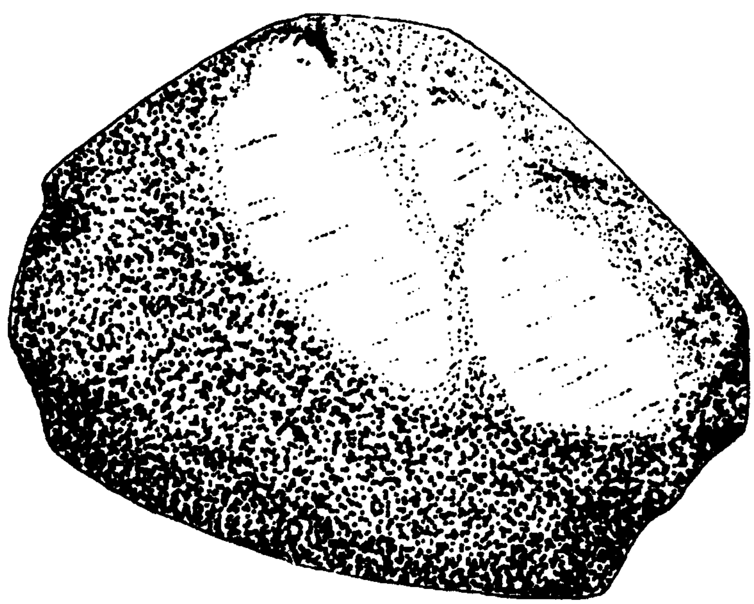
Motion: Scratches occur back and forth, but also show rockering.

Area of use-wear: Worn on one surface.

Relationships

Temporal and *Spatial:* Pebble rockered manos are equally common in Fresnal and Hueco times, but do not seem to carry on into Mesilla or Ceramic times. They may be present in Chiricahua of the Cochise sequence (Haury 1950) but are rarely described adequately. In the Oshara tradition they seem absent.

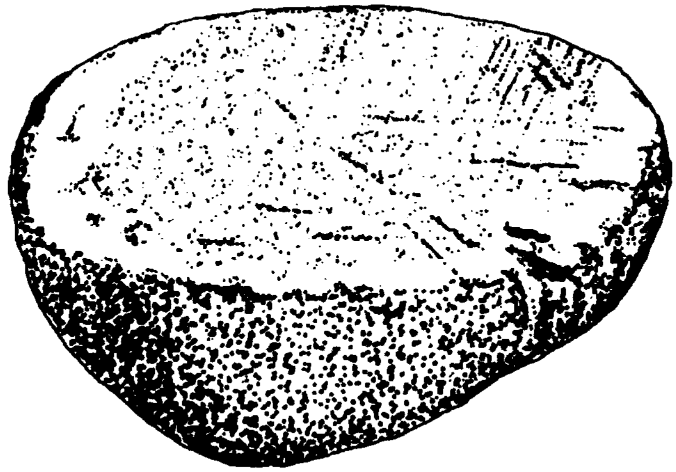
PEBBLE ROCKERED MANO



(drawing = natural size)

TYPE: WEDGE MANO

Source of
Drawing: Todsen Cave, zone J



(*drawing = natural size*)

Sample

Excavation	8
Surface	2
Pictorial	4
Total	**14**

Description (based on a sample of 3)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*		*Dorsal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	93.66	71.0-107.85	83.0	64.0-100.0	78.0	62.0-96.0
Maximum width	85.00	73.6-94.0	72.0	64.9-100.0	71.0	63.0-100.0
Maximum distal width	84.00	73.0-94.0	72.0	64.9-100.0	71.0	63.0-100.0
Maximum proximal width	85.00	75.9-94.0	72.0	64.9-100.0	71.0	63.0-100.0
Maximum thickness	53.00	38.0-69.7				
Maximum distal thickness	53.00	38.0-69.7				
Maximum proximal thickness	34.30	26.6-38.0				
Tip to maximum width	46.00					
Tip to maximum thickness	46.00					
Minimum thickness	12.00					
Tip to minimum thickness	46.00					

Form

Horizontal: Ovoid and rectangular.

Cross section: Distal to proximal–most are plano-plano, but one is disk conex-convex. Left to right–wedge shaped.

Wear

Polish: High on lateral edges on both surfaces.

Motion: Scratches are deep and indicate a back-and-forth movement–away from the grinder, then a turn of the mano to the other surface, then it was drawn toward the grinder.

Area of use-wear: Most were used on two sides, although one was used on three sides.

Relationships

Temporal and *Spatial:* In the Jornada region wedge manos appear in the Middle Archaic and last into Mesilla phase times. Although they seem to occur in other parts of the Southwest, we were unable to determine their exact temporal and spatial ranges.

TYPE: SMALL RECTANGULOID MANO

Source of
Drawing: Todsen Cave, talus

(drawing = ½ natural size)

Sample

Excavation	14
Surface	2
Pictorial	10
Total	**26**

Description (based on a sample of 4 whole ones)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*	
	Mean	**Range**	**Mean**	**Range**
Maximum length	100.20	78.9-133.0	83.7	72.0-91.0
Maximum width	71.00	53.0-96.0	59.0	45.0-81.0
Maximum distal width	59.00	48.0-89.0	42.0	28.0-69.0
Maximum proximal width	66.00	51.0-93.0	46.0	33.0-63.0
Maximum thickness	33.25	23.0-44.0		
Maximum distal thickness	27.25	17.4-41.0		
Maximum proximal thickness	29.50	23.0-39.0		
Tip to maximum width	51.00	40.0-60.0	40.0	28.0-69.0
Tip to maximum thickness	52.00	41.0-58.0		
Minimum thickness	23.00	17.0-30.0		

Form

Horizontal: Rectanguloid, seemingly made from ovoid pebbles or slabs of sandstone that had edges pecked into a rectangular shape both horizontally and vertically.

Cross section: Distal to proximal–disk convex-convex. Left to right–disk convex-convex.

Wear

Polish: The high polish is always along the median axis from the proximal to distal end and fades towards the lateral edges (100%).

Motion: Scratches mainly back and forth from lateral edge to lateral edge (100%); two also have back-and-forth scratches from proximal to distal ends (25%).

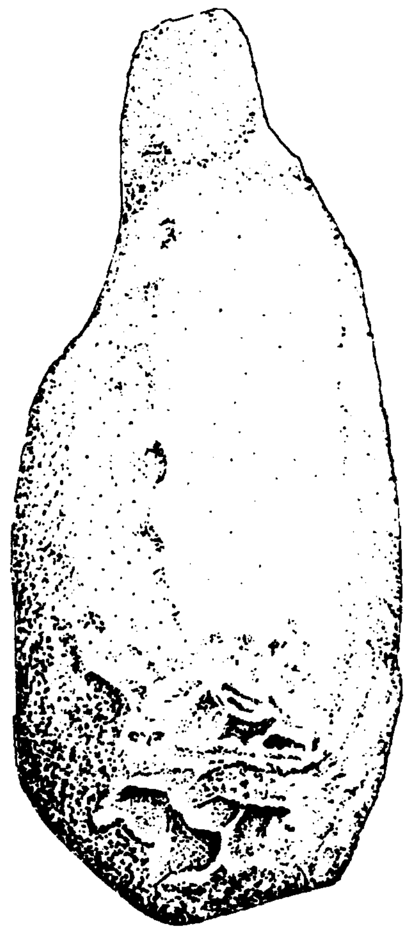
Area of use-wear: Usually just on one side, but a small fragment of one may show bifacial use.

Relationships

Temporal and *Spatial:* In the Hueco area these manos occur mainly in the Hueco and Mesilla phases, rarely in El Paso levels. This matches their distribution in San Pedro times both in the Mogollon Rim (Dick 1965) and the Gila Drainage (Sayles 1983, figures 9.3c-d) as well as Ventana Cave (Haury 1950). They also occur in Basketmaker II in the Colorado Plateau (Guernsey 1931, plate 27).

Small rectanguloid manos are often thought to have been used on corn, but our experiments with hard popcorn kernels showed these manos were not heavy enough to break the kernels and grind them into flour. They did, however, work well on nuts, berries, and mesquite seeds, in other words, on large but not overly hard seeds. They could have been used on any of our metates, but did not work well in the trough ones.

TYPE: COBBLE PESTLE



Source of Drawing: Todsen Cave, zone πJ

(drawing = ½ natural size)

Sample

Excavation	1
Surface	3
Pictorial	4
Total	**8**

Description (based on a sample of 1 whole one)

Dimensions (in mm)

	Whole Artifact		*Distal Worked Area*		*Proximal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	413.0		48.0		45.0	
Maximum width	85.0		41.0		45.0	
Maximum distal width	85.0					
Maximum proximal width	45.0					

	Whole Artifact
	Mean
Maximum thickness	65.00
Maximum distal thickness	60.15
Maximum proximal thickness	57.45
Tip to maximum width	211.00
Tip to maximum thickness	220.00
Minimum thickness	50.00

Form

Horizontal: Elongate ovoid.

Cross section: Distal to proximal–disk convex-convex. Left to right–plano-plano.

Wear

Polish: None; pecking occurs on both ends.

Motion: Up and down.

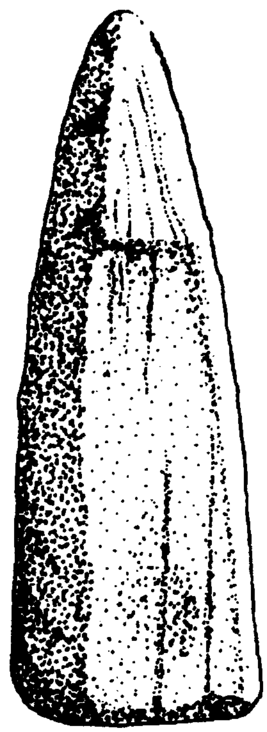
Area of use-wear: Distal and proximal ends.

Relationships

Temporal and *Spatial:* In the Jornada region cobble pestles occur mainly in the Late Preceramic and Early Ceramic; while they occur elsewhere in the Southwest, we could not determine their temporal or spatial distribution.

TYPE: PEBBLE ABRADER

Source of Drawing: Todsen Cave, zone F+



(drawing = natural size)

Sample

Excavation	2
Surface	3
Pictorial	5
Total	**10**

Description (based on a sample of 2)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*		*Dorsal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	114.00	95.0-133.0	88.0	41.0	41.0	
Maximum width	26.00	11.0-35.0	20.1		12.0	
Maximum distal width	14.75	11.7-16.75				
Maximum proximal width	26.48	17.0-35.0				
Maximum thickness	23.50	12.0-29.0				
Maximum distal thickness	15.00	12.0-18.0				
Maximum proximal thickness	23.95	18.5-29.4				
Minimum thickness	10.35	6.0-29.0				
Depth			2.50	2.0-3.0	1.0	
Tip to maximum thickness	50.00					

Form

Horizontal: Ovoid and elongate.

Cross section: Distal to proximal–plano-plano, rarely plano-convex. Left to right–plano-plano.

Wear

Polish: On tip of distal end.

Motion: Back and forth, end to end.

Area of use-wear: One or both sides.

Relationships

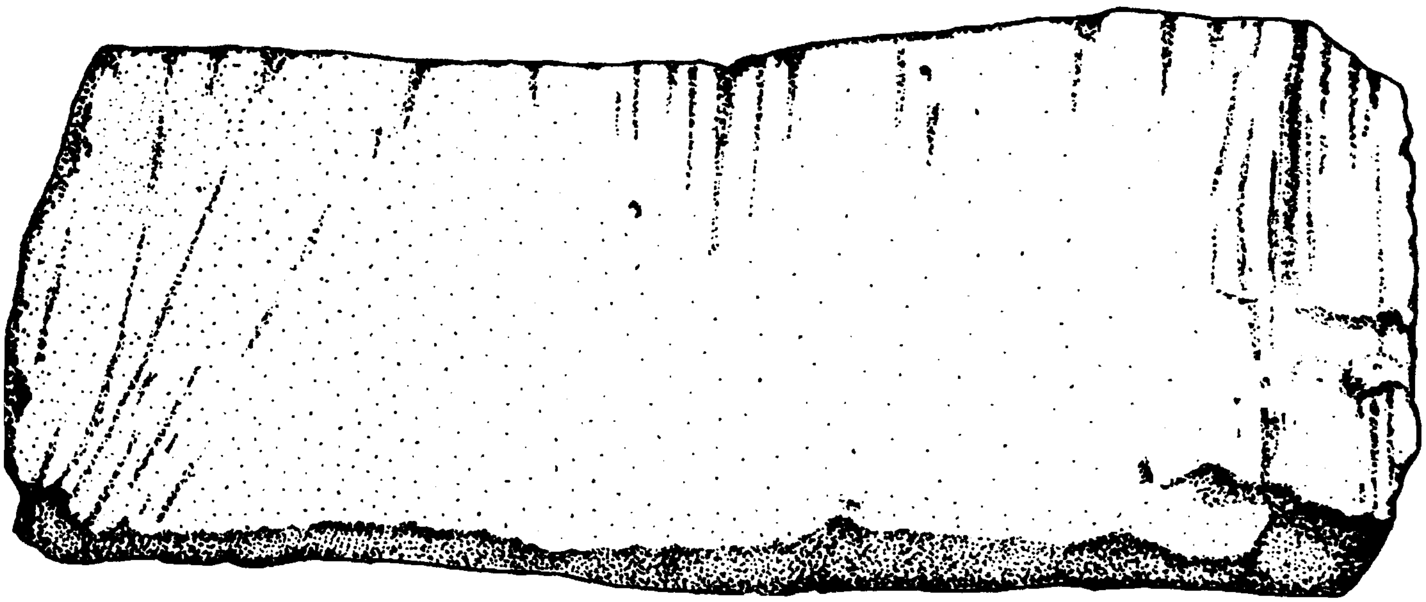
Temporal and *Spatial:* While pebble abraders occurred only with Early Ceramic Mesilla remains, we suspect they start in Hueco times in the Jornada region. Elsewhere, we could not determine their distribution.

TYPE: LONG RECTANGULAR TWO-HANDED MANO

Source of
Drawing: Todsen Cave, zone F+
(see next page)

Sample

Excavation	9
Surface	1
Pictorial	10
Total	**20**



LONG RECTANGULAR TWO-HANDED MANO
(drawing = ½ natural size)

Description (based on a sample of 1)
Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*		*Dorsal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	170.80		59.75		61.0	
Maximum width	53.30		49.00		49.0	
Maximum thickness	32.95					
Tip to maximum width	80.00					
Tip to maximum thickness	82.00					
Minimum thickness	15.00					
Tip to minimum thickness	20.00					

Form

Horizontal: Long, rectangular shape.
Cross section: Distal to proximal–disk convex-convex. Left to right–convex-convex.

Wear

Polish: On edge on both sides.
Motion: Scratches indicate back-and-forth motion, lateral edge to lateral edge.
Area of use: Both sides.

Relationships

Temporal and *Spatial:* Although long, rectangular two-handed manos occurred mainly in Ceramic times, we suspect they first appeared in the Late Archaic (Hueco phase) in the Jornada region. This distribution seems similar in the rest of the Southwest, both in San Pedro Cochise (Sayles 1983, figure 10.3d) and Ventana Cave (Haury 1950, figures 70c-d) as well as in the Colorado Plateau (Morris and Burgh 1954, figure 87a-d).

TYPE: LONG WEDGE TWO-HANDED MANO

No Drawing: Samples too fragmentary to illustrate.

Sample

Excavation	3
Surface	2
Pictorial	10
Total	**15**

Description (based on a sample of 1)

Dimensions (in mm)

	Whole Artifact
	Mean
Maximum length	194.0
Maximum width	80.0
Maximum distal width	68.0
Maximum proximal width	80.0
Maximum thickness	66.0
Maximum distal thickness	58.4
Maximum proximal thickness	65.9
Tip to maximum width	88.0
Tip to maximum thickness	90.0
Minimum thickness	68.0
Tip to minimum thickness	6.0

Form

Horizontal: Long, rectangular shape.
Cross section: Distal to proximal–plano-plano. Left to right–triangular.

Wear

Polish: In middle of worked ventral end.
Motion: Scratches indicate back-and-forth motion from lateral edge to lateral edge.
Area of use-wear: One side.

Relationships

Temporal and *Spatial:* In the Jornada region, as well as in the rest of the Southwest, long wedge two-handed manos seem popular in Late Ceramic times.

Following are descriptions of the receptacle stones (also called nether stones) in which the hand-held stones were used. These include mortars, anvils, mulling stones, and metates.

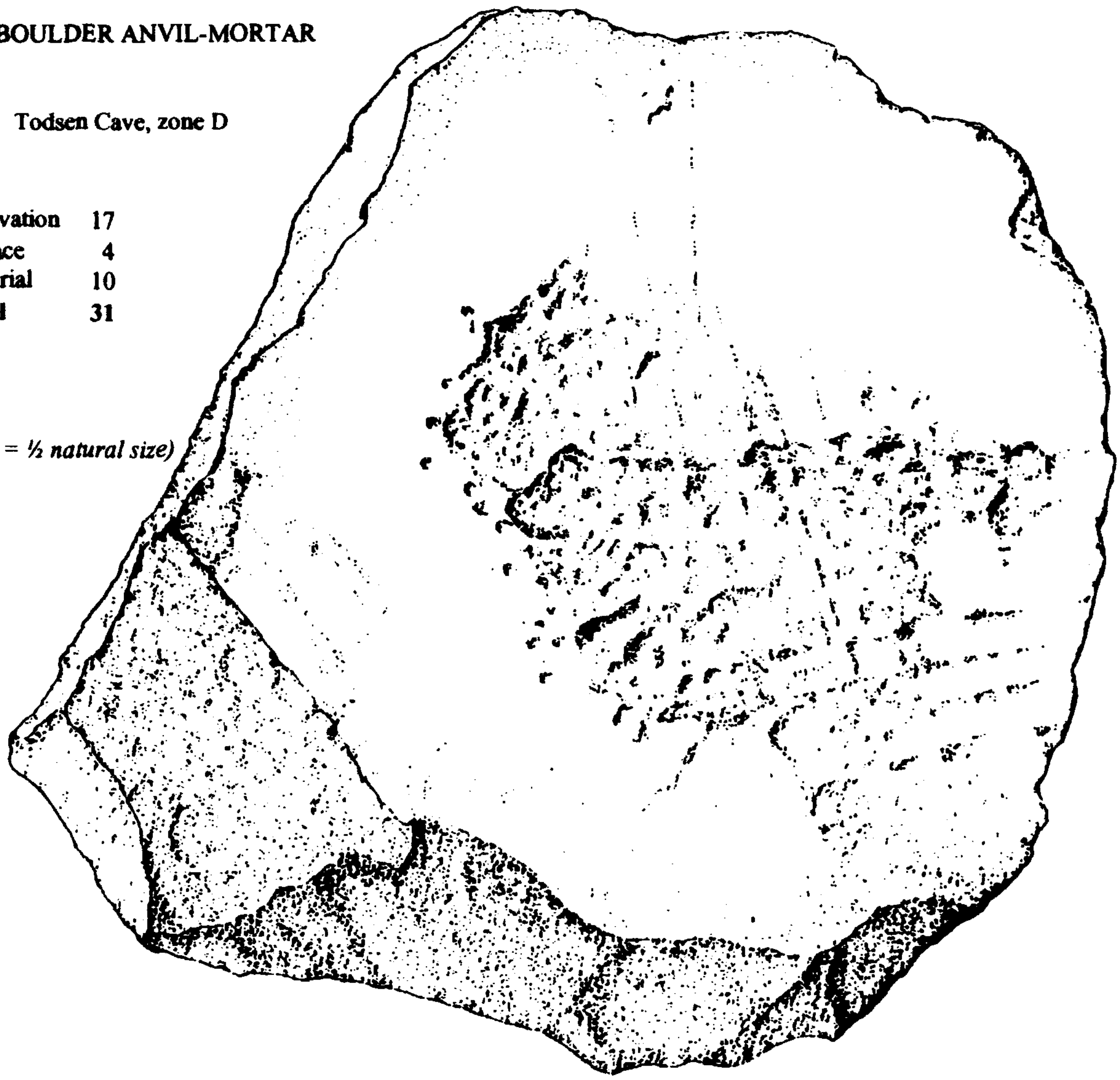
TYPE: BOULDER ANVIL-MORTAR

Source of Drawing: Todsen Cave, zone D

Sample

Excavation	17
Surface	4
Pictorial	10
Total	**31**

(drawing = ½ natural size)



Description (based on a sample of 5)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*		*Dorsal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	215.0	95.0-307.0	107.0	52.0-203.0	65.0	55.0-95.0
Maximum width	203.0	70.0-290.0	108.2	44.0-180.0	48.0	26.0-70.0
Maximum distal width	160.0	40.0-206.0				
Maximum proximal width	187.0	70.0-290.0				
Maximum thickness	75.0	14.0-85.0				
Maximum distal thickness	73.0	50.0-190.0				
Maximum proximal thickness	70.0	28.0-104.0				
Tip to maximum thickness	74.0	35.0-92.0.0				
Minimum thickness	61.0	28.0-95.0	2.4	1.0-5.0	.15	1.0-3.0
Tip to minimum thickness	126.0	50.0-190.0				

Form

Horizontal: Boulder anvil-mortars range from pentagonal (40%) and/or triangular (40%) to squarish (10%) and rectangular (10%).

Cross section: Distal to proximal–from front to back they are mainly plano-convex (60%). Left to right–a few are concave-convex at the end (40%), while from side to side along the midpoint they vary from plano-convex (40%) to concave-convex to plano-plano. Overall they have a sort of reversed conical form.

Wear

Polish and *Motion:* None have any polish and all seem pecked up and down.

Area of use-wear: Mainly the center of the flat or concave (ventral) surface; one also has scratches round and round, and one is pecked on both surfaces.

Relationships

Temporal and *Spatial:* In the Jornada region boulder anvil-mortars appear at least in Early Archaic times and last throughout the sequence in diminishing amounts. We were unable to determine the distribution of boulder anvil-mortars in the rest of the Southwest, but they may be similar to some of the basin-mortars of later cultures. If so, they have a different temporal distribution from that of the Jornada region and might have spread out of it.

TYPE: BOULDER MILLING STONE (TWO SURFACES)

Source of
Drawing: Todsen Cave, zone K
(See next page)

Sample

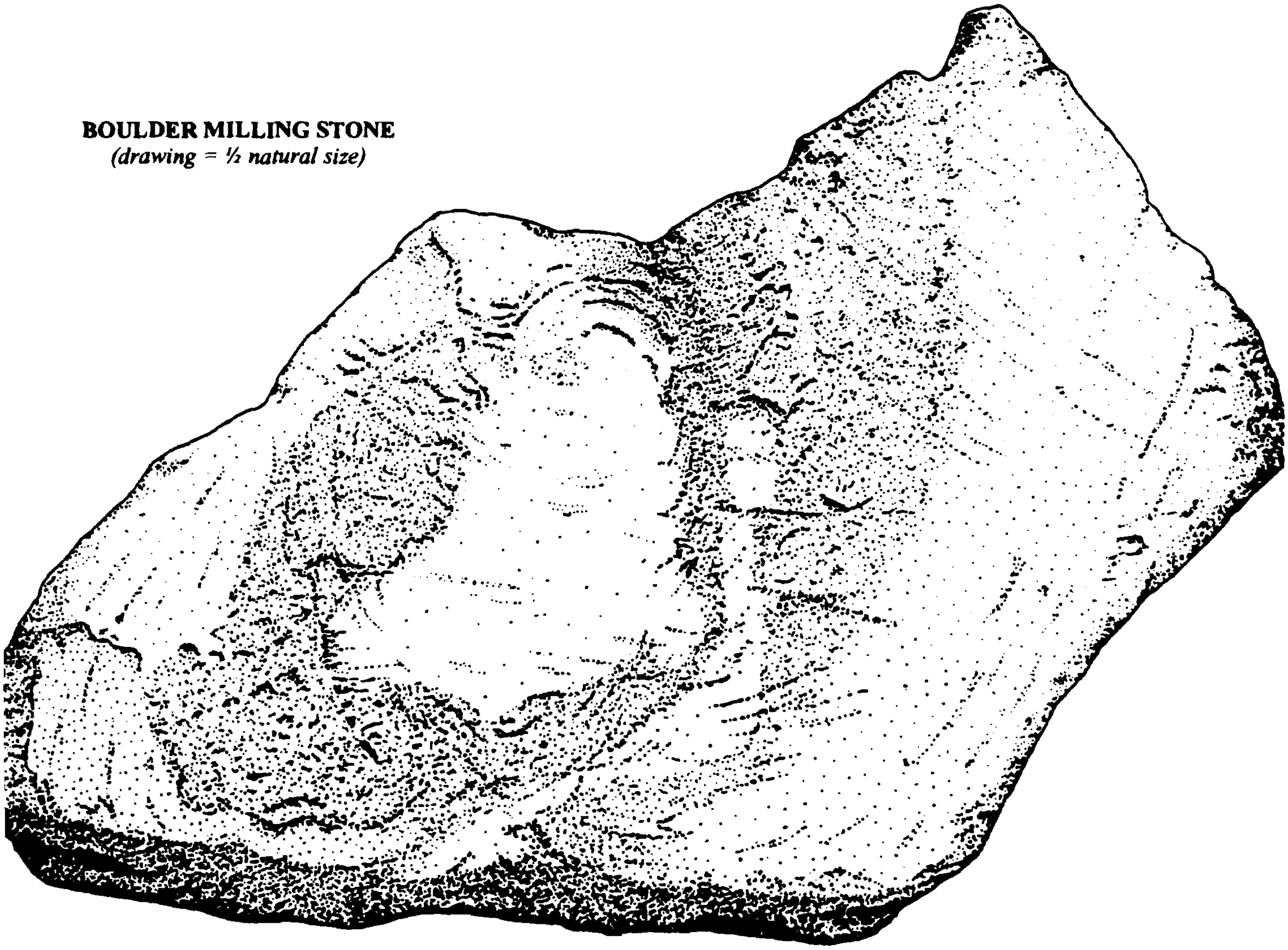
Excavation	2
Surface	6
Pictorial	2
Total	**10**

Description (based on a sample of 2)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*		*Dorsal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	255.0	234.0-275.0	120.0	105.0-156.0	71.0	40.0-96.0
Maximum width	199.0	137.0-260.0	86.0	73.0-98.0	68.0	45.0-90.0
Maximum distal width	153.0	120.0-186.0				
Maximum proximal width	242.0	234.0-250.0				
Maximum thickness	78.0	60.0-93.0				
Maximum distal thickness	51.0	45.0-?				
Maximum proximal thickness	60.0	30.0-?				
Tip to maximum thickness	103.0	70.0-135.0				
Minimum thickness	43.0	?-56.0				
Tip to minimum thickness	38.0	10.0-65.0	1.50	1.0-3.0	1.0	1.0

BOULDER MILLING STONE
(drawing = ½ natural size)



Form

Horizontal: One sample is rectanguloid; the other is trianguloid. From end to end the latter is plano-concave; the other is plano-plano.

Cross section: Left to right at midpoint–the latter is plano-convex while the other is convex-convex.

Wear

Polish: Always circular.

Motion: Round and round.

Area of use-wear: The center of both the dorsal and ventral surfaces.

Relationships

Temporal and *Spatial:* Although our sample is very small, it seems to indicate boulder milling stones occurred in the Early and Middle Archaic; however, we suspect their use continued into later times. In the Cochise tradition (where they often are called bifacial metates or basin mortars), bolder milling stones supposedy occur in the late part of the sequence (Sayles 1983, figure 9.3). This occurrence also may be true for the Oshara tradition (Irwin-Williams 1973, figure 7; Morris and Burgh 1954, figure 89).

TYPE: BOULDER UNIFACIAL MILLING STONE

Drawing: None

Sample

Excavation	11
Surface	6
Pictorial	6
Total	**23**

Description (based on a sample of 3)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*	
	Mean	**Range**	**Mean**	**Range**
Maximum length	220.7	44.5-365.0		30.6-190.0
Maximum width	140.0	35.0-235.0		24.4-110.0
Maximum distal width	80.0	3.70-156.0		
Maximum proximal width	98.0	26.5-172.0		
Maximum thickness	48.0	8.10-83.0		
Maximum distal thickness	41.0	5.90-78.0		
Maximum proximal thickness	38.0	7.30-67.0		
Tip to maximum thickness	115.0	31.0-170.0		
Minimum thickness	28.0	5.10-62.0		
Tip to minimum thickness	159.0	17.8-260.0	1.5	1.0-2.50

Form

Horizontal: Mainly rectanguloid, but also ovoid, pentagonal, and septagonal.

Cross section: Distal to proximal–from end to end most are plano-concave, while a few are convex-concave; from side to side they mainly are plano-concave, with one plano-plano.

Wear

Polish: Occurs only on the ventral surface, which often is concave.

Motion: Circular; most of the scratches indicate a round-and-round motion, although one has some back-and-forth scratches.

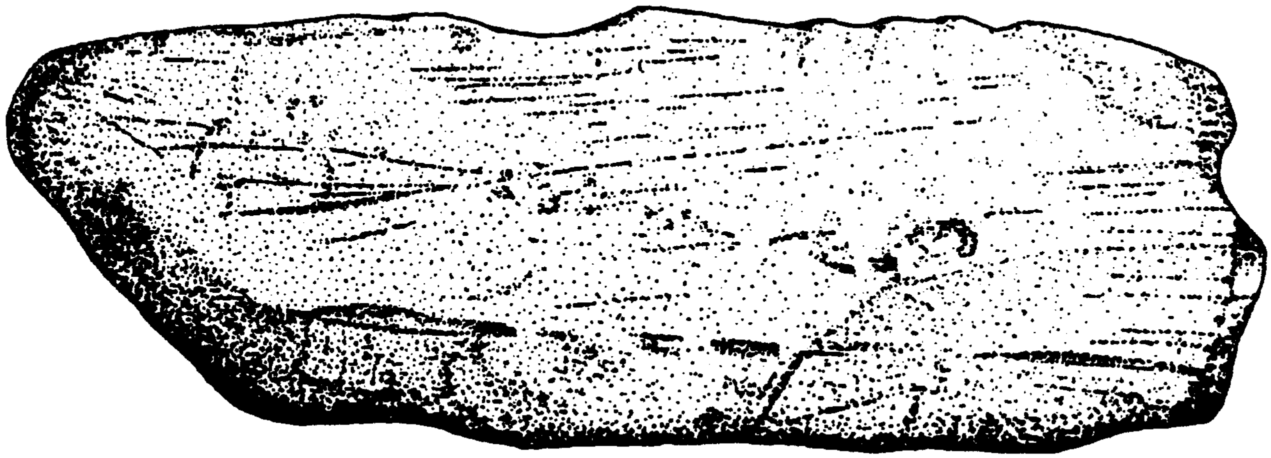
Area of use-wear: Always one ventral surface, ranging from the center to all edges.

Relationships

Temporal: In the Jornada region boulder unifacial milling stones occur mainly in the Middle and Late Archaic; they are rare or absent in Ceramic times. (Since our sample is limited, they might occur earlier or later than those found in our excavations.) Perhaps both the bifacial and unifacial milling stones should be lumped together as a single type since their temporal significance is not well marked.

Spatial: In the Cochise sequence these milling stones seem to be the basin types (Waters 1986, figure 4.2), occurring in the Chiricahua (Haury 1950, figures 69a-c), San Pedro (Dick 1965, figure 38; Martin et al. 1952, figures 37 and 38), and in Early Ceramic phases, as in the Jornada region. In the Oshara tradition they have a similar range, occurring in San Jose, Armijo, and perhaps En Medio phases.

TYPE: SLAB METATE (UNIFACIAL)



Source of *(drawing = ½ natural size)*
Drawing: Todsen Cave, zone J

Sample

Excavation	12
Surface	7
Pictorial	5
Total	**24**

Description (based on a sample of 5)
Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*	
	Mean	**Range**	**Mean**	**Range**
Maximum length	236.0	156.0-295.0		55.0-220.0
Maximum width	133.0	98.0-222.0		42.0-80.0
Maximum distal width	59.0	30.0-89.0	0.25*	0-1.0
Maximum proximal width	109.0	53.0-185.0		
Maximum thickness	40.0	36.0-46.0		
Maximum distal thickness	31.0	22.0-41.0		
Maximum proximal thickness	34.0	17.0-46.0		
Tip to maximum thickness	71.0	31.0-156.0		
Minimum thickness	16.0	14.0-21.0		
Tip to minimum thickness	183.0	46.0-239.0		

**Concavity*

Form

Horizontal: Generally ovoid in outline, but some are rectanguloid (20%) and even triangular (20%).

Cross section: Distal to proximal–from end to end bifacial slab metates often are plano-plano with some being plano-concave, plano-convex, and convex-concave. Left to right–mainly plano-plano; some plano-concave or convex-concave.

Wear

Polish and *Motion:* Polish is back and forth, mainly in the center, indicating a back-and-forth motion. One sample also shows round-and-round motion on one surface.

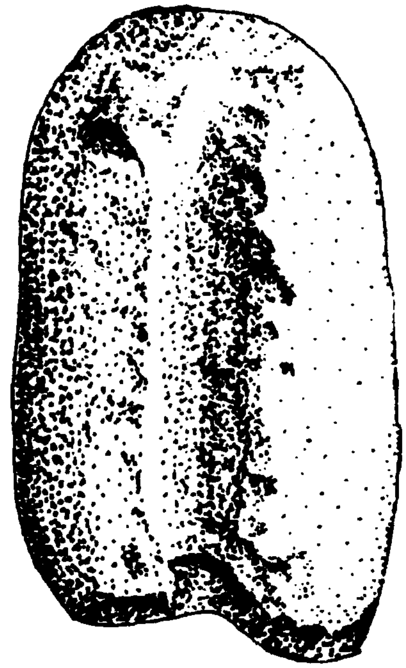
Area of use-wear: All were used unifacially only. On the more concave surface the greatest wear was in the center, but may also extend to the edges.

Relationships

Temporal and *Spatial:* Unifacial slab metates are prominent (20%+) in the Middle and Late Archaic and might last into the Early Ceramic (Mesilla) phase. In the Cochise sequence these metates supposedly start in Sulphur Springs (Waters 1986), before 7000 B.C., and are most popular in Chiricahua times but purportedly are absent in San Pedro times (Haury 1950, figures 69e-f). If this is true, perhaps our Jornada metates spread into the region from the west. Their exact distribution in the Oshara tradition is difficult to determine, but we found some examples in San Jose levels at Rio Cuervo.

TYPE: SINEW STONE

Source of
Drawing: Todsen Cave, zone πJ



(drawing = natural size)

Sample

Excavation	11
Surface	2
Pictorial	6
Total	**19**

Description (based on a sample of 5)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*		*Dorsal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	80.0	38.0-137.0	51.0	36.0-64.0	75.0	34.0-115.0
Maximum width	73.0	60.0-115.0	20.0	16.0-23.0	20.0	10.0-30.0
Maximum distal width	29.0	8.0-55.0				
Maximum proximal width	57.0	44.0-94.0				
Maximum thickness	32.0	26.0-41.0				
Maximum distal thickness	15.0	12.0-25.0				
Maximum proximal thickness	22.0	19.0-35.0				
Tip to maximum thickness	53.0	1.0-130.0				
Minimum thickness	14.0	11.0-18.0				
Tip to minimum thickness	41.0	1.0-79.0	1.50*		5.0*	1.0-10.0*

**Concavity*

Form

Horizontal: More than 40% of these sinew stones are rectanguloid, but some are ovoid, trianguloid, and pentagonoid.

Cross section: Distal to proximal-from end to end most are plano-convex (40%), but some are plano-concave, convex-concave, and convex-convex. Left to right-most are slightly different, being plano-plano, convex-convex, plano-convex, plano-concave, and convex-concave.

Wear

Polish: When it occurs, is along the central longitudinal axis, although one sample was slightly diagonal.

Motion: Mainly back and forth, made by something with a narrow edge; one sample seemed to show back-and-forth motion in a long, ovoid track.

Area of use-wear: One surface, usually in the longitudinal center.

Relationships

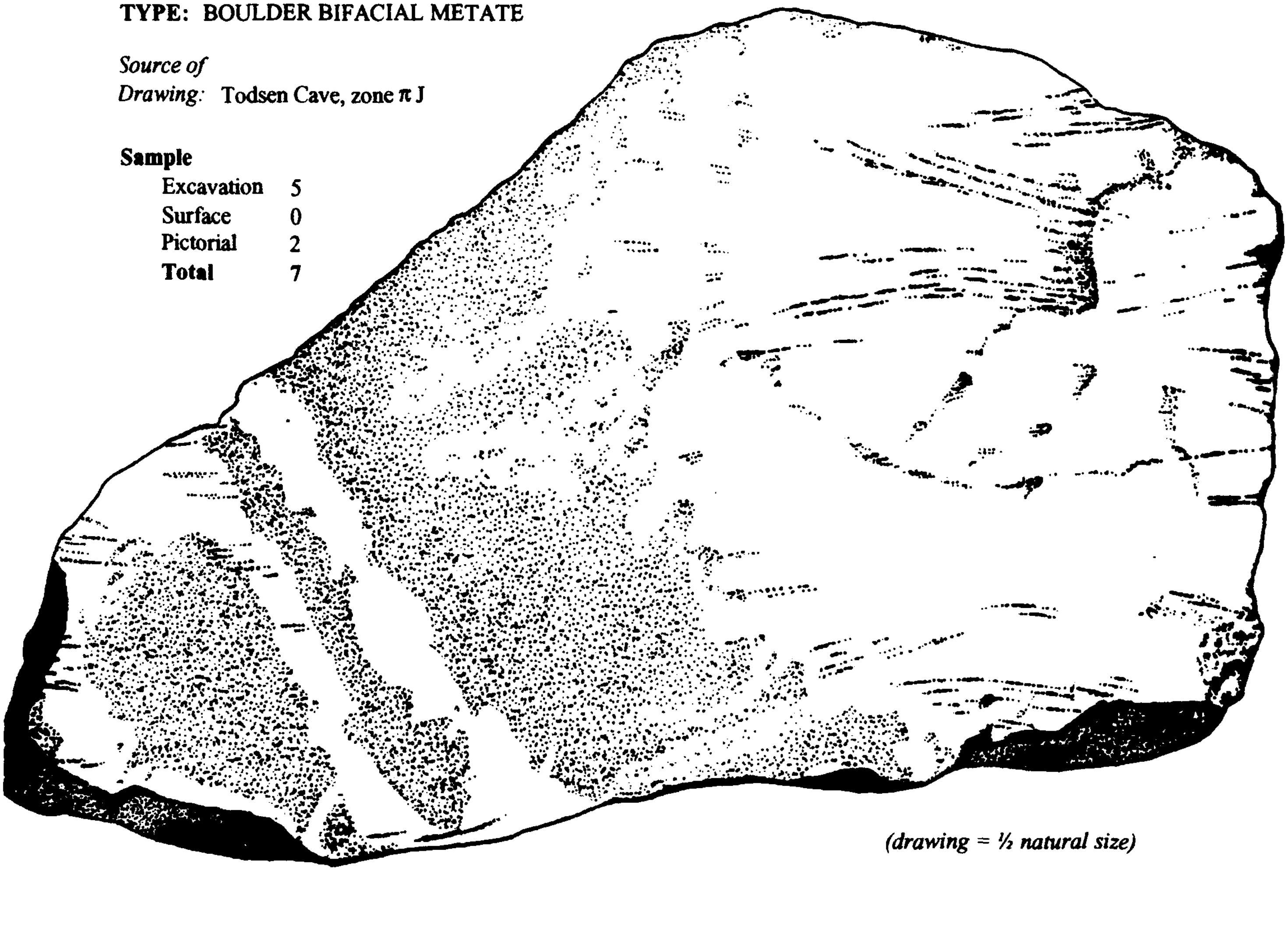
Temporal and *Spatial:* In the Jornada region sinew stones appear in late Middle Archaic times (2300 B.C.±) and last into Early Ceramic times. Elsewhere in the Southwest we were unable to determine their distribution, but they seem to occur in the Mogollon Rim (Martin et al. 1952, figure 43) and the Colorado Plateau (Morris and Burgh 1954, figures 87h-i).

TYPE: BOULDER BIFACIAL METATE

Source of Drawing: Todsen Cave, zone π J

Sample

Excavation	5
Surface	0
Pictorial	2
Total	7



(drawing = ½ natural size)

Description (based on a sample of 2)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*		*Dorsal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	389.0	348.0-430.0	344.0	268.0-420.0	199.0	188.0-210.0
Maximum width	217.0	190.0-244.0	155.0	127.0-183.0	183.0	180.0-185.0
Maximum distal width	122.0	99.0-144.0				
Maximum proximal width	154.0	149.0-159.0				
Maximum thickness	100.0	77.0-133.0				
Maximum distal thickness	96.0	77.0-115.0				
Maximum proximal thickness	66.0	58.0-73.0				
Tip to maximum thickness	70.0	60.0-80.0				
Minimum thickness	59.0	53.0-65.0				
Tip to minimum thickness	230.0	207.0-252.0	6.0*	2.0-10.0*	2.0*	1.0-3.0*

**Concavity*

Form

Horizontal: Ovoid to rectanguloid.

Cross section: Distal to proximal–plano-plano to plano-concave. Left to right–plano-concave to plano-plano.

Wear

Polish: On the ventral, back and forth with some diagonally from left to right corners; on the dorsal it is both circular and back and forth.

Motion: Scratches indicate a back-and-forth motion, both ventral and dorsal, probably by a mano.

Area of use-wear: Both surfaces are polished mainly in the center of the receptacle.

Relationships

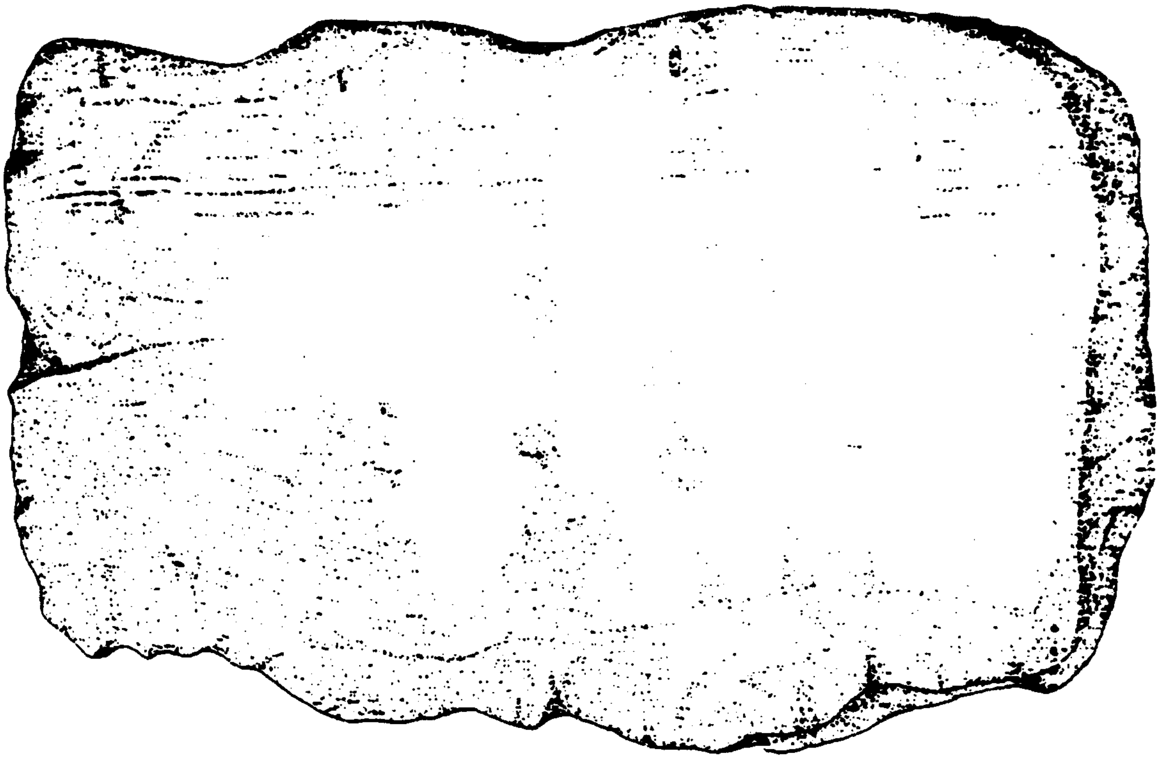
Temporal and *Spatial:* In the Jornada region, boulder bifacial metates occur mainly in the late Middle Archaic, Late Archaic, and perhaps Early Ceramic times. This occurrence is similar to their distribution in the Cochise region, where some of the basin mortars occur in Chiricahua (Haury 1950, figures 69e-f), San Pedro (Dick 1965), and Early Ceramic times. In the Colorado Plateau region we could not determine their distribution but they may start early (Lindsay et al. 1968, table 22).

TYPE: BOULDER ROCKERED METATE (UNIFACIAL)

Source of
Drawing: Todsen Cave,
zone J (see next page)

Sample

Excavation	4
Surface	1
Pictorial	0
Total	**5**



BOULDER ROCKERED METATE
(drawing = ½ natural size)

Description (based on a sample of 3)
Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*		*Dorsal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	265.0	220.0-311.0	247.0	245.0-249.0	182.0	
Maximum width	172.0	165.0-180.0	142.0	123.0-161.0		
Maximum distal width	123.0	93.0-155.0				
Maximum proximal width	142.0	128.0-160.0				
Maximum thickness	87.0	45.0-116.0				
Maximum distal thickness	64.0	24.0-110.0				
Maximum proximal thickness	80.0	42.0-109.0				
Tip to maximum thickness	147.0	90.0-202.0				
Minimum thickness	33.0	15.0-58.0				
Tip to minimum thickness	62.0	26.0-76.0	1.50*	0-3.0*	0.5*	

**Concavity*

Form

Horizontal: Rectanguloid.

Cross section: Distal to proximal–mainly plano-plano, but one was plano-concave. Left to right–also mainly plano-plano, with one plano-concave.

Wear

Polish: On both the distal and proximal edges or ends.

Motion: Scratches indicate rockering back and forth.
Area of use-wear: Usually just on one side, usually worked along the distal and proximal edges; one is worked all over.

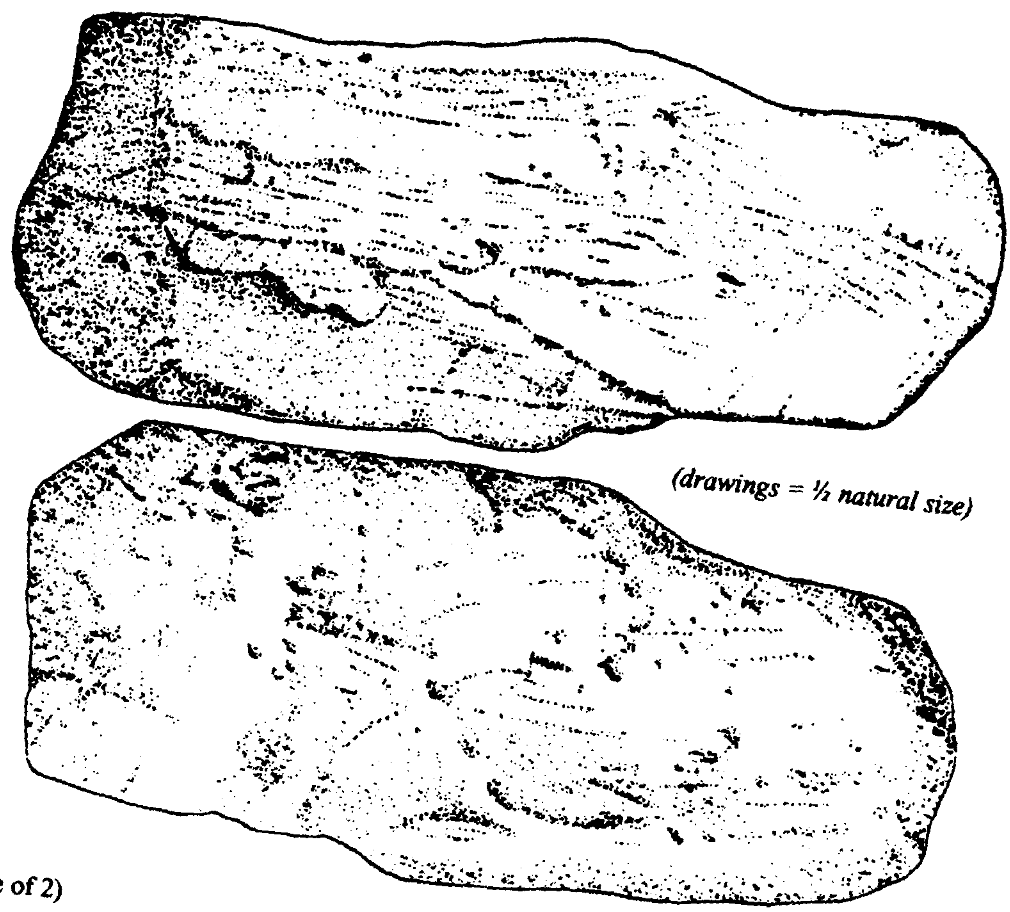
Relationships
Temporal and *Spatial:* All the boulder rockered metates we found in excavation were of Middle Archaic times, but surface collections hint they may last into the Late Archaic. Their distribution in the rest of the Southwest could not be determined.

TYPE: BIFACIAL SLAB METATE

Source of Drawings: Todsen Cave, zone πJ

Sample

Excavation	5
Surface	2
Pictorial	1
Total	*8*



(drawings = ½ natural size)

Description (based on a sample of 2)
Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*		*Dorsal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	251.0	220.0-281.0	126.0	110.0-142.0	121.0	95.0-146.0
Maximum width	98.0	85.0-111.0	59.0	56.0-62.0	50.0	40.0-60.0
Maximum distal width	77.0	23.0-80.0				
Maximum proximal width	98.0	84.0-111.0				

	Mean	Range	Mean	Range	Mean	Range
Maximum thickness	64.0	32.0-95.0				
Maximum distal thickness	29.0	18.0-39.0				
Maximum proximal thickness	43.0	10.0-75.0				
Tip to maximum thickness	120.0	107.0-133.0				
Minimum thickness	20.0	7.0-33.0				
Tip to minimum thickness	125.0	30.0-220.0	2.0*	1.0-3.0*	7.0*	5.0-8.0*

**Concavity*

Form

Horizontal: Rectanguloid.

Cross section: Distal to proximal–plano-plano and plano-convex. Left to right–same as distal to proximal.

Wear

Polish: Ventrally, polish is longitudinal, indicating a back-and-forth motion; one sample with polish diagonally still indicates a back-and-forth motion.

Motion: Generally back and forth, but some scratches are circular, indicating use round and round.

Area of use-wear: All have been bifacially used, either on the longitudinal center line or on one edge longitudinally.

Relationships

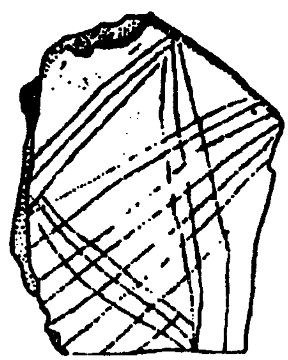
Temporal and *Spatial:* Bifacial slab metates appear in the Late Archaic or Hueco phase in the Jornada region and last into Ceramic times. What their distribution is elsewhere in the Southwest could not be determined.

TYPE: PAINT PALETTE

Source of
Drawing: Todsen Cave, zone F+

Sample

Excavation	19
Surface	2
Pictorial	2
Total	**23**



(drawing = ½ natural size)

Description (based on a sample of 3)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*		*Dorsal Worked Area*	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**
Maximum length	99.7	77.0-143.0	67.0	57.0-77.0	41.0	31.0-51.0
Maximum width	54.3	47.0-61.0	49.0	36.0-61.0	25.0	21.0-28.0
Maximum distal width	24.0	14.0-42.0				
Maximum proximal width	38.0	16.0-55.0				

	Mean	Range
Maximum thickness	16.0	14.0-18.0
Maximum distal thickness	12.0	8.0-16.0
Maximum proximal thickness	10.0	6.0-12.0
Tip to maximum thickness	55.0	30.0-79.0
Minimum thickness	9.0	6.0-12.0
Tip to minimum thickness	61.0	5.0-140.0

Form

Horizontal: Ranges from ovoid to trianguloid.

Cross section: Distal to proximal–mainly plano-plano, with one sample plano-convex. Left to right–same as distal to proximal.

Wear

Polish: Generally absent.

Motion: Many scratches indicate a circular grinding motion; one sample also may have been rockered.

Area of use-wear: Mainly on one side, but occasionally paint palettes are used bifacially (20%). The use is mostly in the center (80%), but a few show use on the lateral edges.

Relationships

Temporal and *Spatial:* Paint palettes appear in Late Preceramic times, becoming more numerous in the Ceramic phases. They seem roughly equivalent to Cochise sequence lapstones, which start in Chiricahua times, reach their zenith in San Pedro times, and die out in Ceramic times (Martin et al. 1952, figure 40). In the Oshara tradition we could not determine their temporal distribution, but they do occur in Basketmaker II times (Morris and Burgh 1954, figures 87j-l).

TYPE: TROUGH METATE

Source of
Drawing: Bill Ward collection, Orogrande, NM
(See next page)

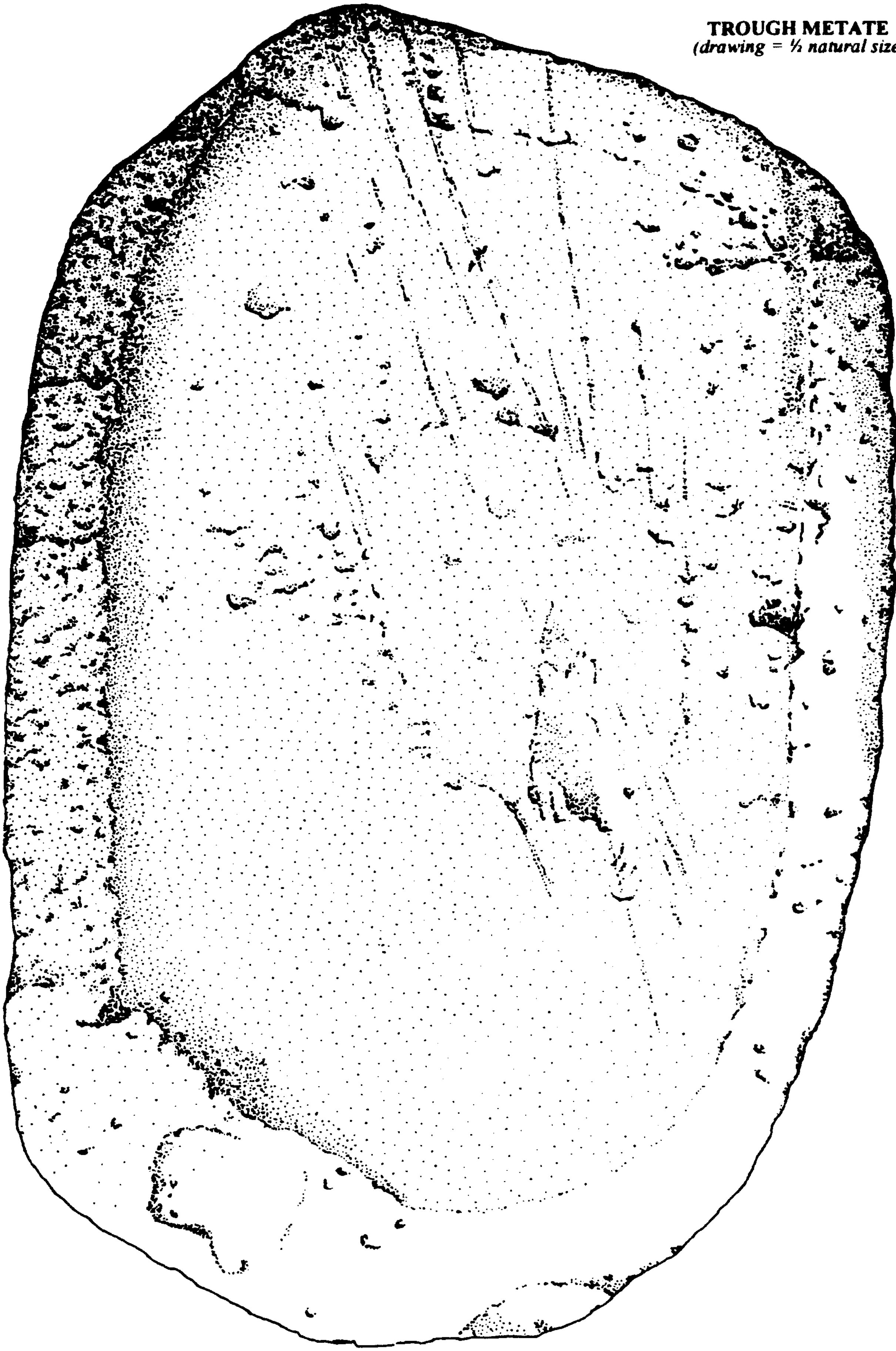
Sample

Excavation	9
Surface	2
Pictorial	6
Total	**17**

Description (based on a sample of 2)

Dimensions (in mm)

	Whole Artifact		*Ventral Worked Area*	
	Mean	**Range**	**Mean**	**Range**
Maximum length	270.0	113.0-423.0	238.0	84.0-391.0
Maximum width	133.0	94.0-213.0	114.0	88.0-180.0
Maximum distal width	104.0	48.0-160.0		
Maximum proximal width	132.0	84.0-180.0		


TROUGH METATE
(drawing = ½ natural size)

	Mean	Range	Mean	Range
Maximum thickness	34.3	23.0-44.0		
Tip to maximum thickness	268.0	113.0-420.0		
Minimum thickness	10.0	6.0-13.0		
Tip to minimum thickness				10.0-22.0*

**Concavity*

Form

Horizontal: All trough metates are roughly rectanguloid.

Cross section: Distal to proximal–convex-concave or plano-concave. Left to right–convex-U-shaped.

Wear

Polish: Relatively well polished.

Motion: Scratches indicate back-and-forth motion, but sometimes motion is criss-cross. Scratches tend to be deeper and more numerous on the proximal end.

Area of use-wear: Only one surface, used lengthwise all over the trough.

Relationships

Temporal and *Spatial:* Trough metates appear in the Hueco phase and become increasingly important in Ceramic times, particularly in the El Paso phase in the Jornada region. They seem to have a similar temporal distribution in the Colorado Plateau (Kidder 1932, figure 43). To the west they seem to occur mainly in Ceramic times (Gladwin et al. 1937, figures LXVII and LXVIII). Trough metates generally are thought of as being used mainly to grind corn with a two-handed heavy mano.

TYPE: MEXICAN METATE

Drawing: None

Sample

Excavation	6
Surface	2
Pictorial	2
Total	**10**

Description (based on a sample of 1)

Dimensions (in mm)

	Whole Artifact	*Ventral Worked Area*
	Mean	**Mean**
Maximum length	290.0	266.0
Maximum width	188.0	120.0
Maximum distal width	176.0	
Maximum proximal width	177.0	
Maximum thickness	25.0	
Maximum distal thickness	18.0	
Maximum proximal thickness	19.0	

	Mean	Mean
Tip to maximum thickness	152.0	
Minimum thickness	18.0	
Tip to minimum thickness	2.0	5.0*

Concavity

Form

Horizontal: Rectanguloid.
Material: All were made of volcanic tufa.
Cross section: Distal to proximal–plano-concave; some may be footed. Left to right–plano-concave.

Wear

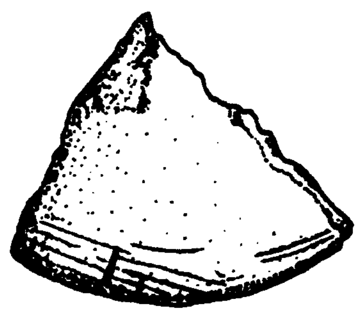
Polish: Down the center on the ventral surface.
Motion: Scratches indicate back-and-forth motion with a two-handed mano.
Area of use-wear: Used all over the ventral surface.

Relationships

Temporal and *Spatial:* While one Mexican metate was found in a Mesilla phase level, we believe these metates are more common in El Paso times. We could not determine their distribution in other parts of the Southwest.

TYPE: GROUND DISK (SUN DISK?)

Source of
Drawing: Todsen Cave, zone D



Sample

Excavation	1
Surface	0
Pictorial	3
Total	**4**

(drawing = natural size)

Description (based on a sample of 1)
Dimensions (in mm)

	Whole Artifact Mean
Maximum length	88.0
Maximum width	88.0
Maximum thickness	7.5

Form

Horizontal: Circular.
Cross section: Distal to proximal–slightly convex-convex. Left to right–slightly convex-convex.

Wear

Polish: None.

Motion: A back-and-forth and round-and-round motion was used to manufacture these ground disks, but they probably were ornaments rather than grinding tools.

Relationships

Temporal and *Spatial:* One ground disk occurred in an El Paso phase floor. Locally such disks are called sun disks, implying they had ceremonial significance. Their distribution in the Southwest could not be determined.

Section 6

Bone and Shell Artifacts

From Todsen Cave we recovered 329 bone and shell artifacts, 266 of them notched bone beads. As a group, they are a nebulous lot, but some do seem to be good time markers. Since our sample from any excavated zone was small, it is inadequate for any but tenuous conclusions. We hope future excavations will improve this situation.

Fragments of polished bone, probably parts of bone tools, and worked antler tines were found in all levels and thus occur throughout the sequence. They are too general to describe in the following section in any detail.

The two types of bone tools used for piercing–split bone awls (7) and ulna-shaped awls (2)–seem to follow each other in our Archaic sequence, but our excavated sample was most inadequate. One final bone tool, a rasp, also occurred in our Ceramic levels.

The rest of the bone and shell types could be classed as ornaments rather than tools. Tubular bone beads and cut olivella shell beads or tinklers appear early, while notched tubular bone beads and bone disk beads occur in Late Archaic times. The other shell ornaments (disk beads, squares, bracelets), otolith beads, and cut turtle shells are of Ceramic times.

Although the list of artifacts is not impressive, we hope it will be useful for future investigators.

Table IV-8. Temporal Relationships of Bone and Shell Artifacts

	LA5531, Zone K1	LA5531, Zone K	LA5531, Zone J1	LA5531, Zone J	LA5531, Zone F	LA5531, Zone wJ	LA5531, Zone D2	LA5531, Zone F+	LA5531, Zone D1	LA5531, Zone D	TOTAL
Cut Turtle Shell								1		1	**2**
Notched Glycymeris Bracelet								1	1	3	**5**
Otolith Bead								1			**1**
Bone Rasp								1			**1**
Square Cut Conch Shell							1				**1**
Cardium Shell Disk Bead							1	2		1	**4**
Ulna Bone Awl						1	1				**2**
Bone Disk Bead						1				1?	**2**
Notched Bone Bead			1	6	2	257					**266**
Olivella Shell Bead			1	1		2				?	**4**
Tubular Bone Bead		2		1		1					**4**
Split Bone Awl		1		1		5					**7**
Worked Antler Tine	1	3	2	2		1	1	1	1	2	**14**
Polished and/or Cut Bone	4	2	1	3	1	1	2	2		1	**17**
TOTAL											**330**
PHASE	**GS**	**K**		**F**		**H**	**M**		**EP/DA**		

KEY:

GS = Gardner Springs
K = Keystone
F = Fresnal
H = Hueco
M = Mesilla
EP = El Paso
DA = Doña Ana

TYPE: POLISHED BONE

We found 17 examples in all excavated levels of Todsen Cave. They probably were part of tools of various kinds.

TYPE: WORKED ANTLER TINES

We found 14 tips of antlers in most excavated zones of Todsen Cave. They range from small fragments, roughly 20 mm long, to whole antlers with a couple of tines more than 100 cm long. All have nicks on their tips, suggesting they probably were used as flakers, that is, tools used with applied pressure to remove small flakes of flint.

TYPE: TUBULAR BONE BEADS

Sample
4 from excavation

Dimensions (in mm)

	Mean	Range
Length	18.0	12.0-33.0
Width (diameter)	8.0	6.0-13.0
Thickness (of wall)	1.3	0.8-1.80

Form and Manufacturing Technique
The tubular bone beads are made from bird (crane?) leg bones that have been sawed to make small tubes. Three of the four are highly polished, which we believe occurred because they had rubbed against something when they were strung as necklaces.

Relationships
Tubular bone beads occur throughout our Archaic and Ceramic sequence and are common in the Southwest (Haury 1950).

TYPE: OLIVELLA SHELL BEAD

Sample
4 from excavation

Dimensions (in mm)

	Mean	Range
Length	32.0	28.0-44.0
Width (diameter)	16.0	12.0-19.0

Form and Manufacturing Technique
All these beads are made from olivella shells, which come from the Pacific Ocean and have their fulcrum sawed off so they can be strung.

Relationships
Olivella shell beads occur in the Middle and Late Archaic and in Ceramic levels in the Jornada region and are common in Ceramic times in the Southwest.

TYPE: NOTCHED BONE BEADS

Sample

269 from excavation

Dimensions (in mm)

	Mean	Range
Length	22.0	12.0-31.0
Width of bead	8.0	6.0-9.0
Width of hole	6.0	4.0-8.0
Thickness	0.8	0.6-1.30

Form and Manufacturing Technique

These beads are sawed from bird leg bones and then partially sawed (in 1 to 3 places, averaging 2.3) to give them a notched appearance. While some may have served as beads for necklaces, those from burial had been sewn together, 6 to 11 8-mm wide beads, to form a sash about 400 mm long.

Relationships

In the Jornada region, notched bone beads seem to be mainly of Late Archaic (Hueco) times, although a few (6) occurred in Fresnal levels. Their distribution elsewhere in the Southwest could not be determined.

TYPE: BONE DISK BEAD

Sample

2 from excavation

Dimensions (in mm)

	Mean	Range
Maximum diameter	6.00	4.0-7.0
Diameter of hole	1.20	0.8-1.40
Thickness	0.90	0.6-1.60

Form and Manufacturing Technique

These beads were made from bone cylinders, probably bird leg bones, that were sawed into thin 1-mm sections.

Relationships

Bone disk beads occur in Late Archaic and Ceramic times in the Jornada region, and are common in the Southwest in Ceramic times.

TYPE: SPLIT BONE AWLS

Sample

7 from excavation

Dimensions (in mm)

	Mean	Range
Length	50.0	18.0-61.0
Maximum width	17.0	11.0-18.0
Maximum thickness	6.0	4.0-9.0

Form and Manufacturing Technique

These awls are made from splinters, probably pointed, of the long bones of large mammals (deer?). The bones have had their pointed end ground to a long, sharp point; polish on the tip suggests they have often been used as awls.

Relationships

Split bone awls occur throughout the Jornada sequence and are common over a similar time span in the Southwest as well as elsewhere.

TYPE: ULNA BONE AWLS

Sample

1 from excavation

Dimensions (in mm)

	Mean
Length of pointed end	60.0±
Length of arm	20.0±
Maximum width	8.0
Maximum thickness	4.0

Form and Manufacturing Technique

These awls are deer ulna that have had their main shafts split and then ground to a point, leaving the ulna head as the base of the awl.

Relationships

The one complete specimen came from a Late Archaic (Hueco phase) level, and a possible fragment came from a Mesilla phase level. In the Southwest ulna bone awls often are thought of as diagnostic of Basketmaker in the Colorado Plateau region (Guernsey and Kidder 1921, figure 92).

TYPE: SHELL DISK BEADS

Sample

4 from excavation

Dimensions (in mm)

	Mean	Range
Maximum diameter	7.20	4.0-9.0
Diameter of hole	1.10	0.8-1.60
Thickness	0.90	0.6-1.60

Form and Manufacturing Technique

These beads were made from Cardium shells (about 1-mm thick) that first were cut into disks and then pierced by a (bow) drilled hole.

Relationships

Shell disk beads occur in Ceramic times in the Jornada region as well as the rest of the Southwest.

TYPE: SHELL RECTANGLE

Sample
1 from excavation

Dimensions (in mm)

	Mean
Length	24.0
Width	18.0
Thickness	3.0

Form and Manufacturing Technique

The sample specimen is made from a thick piece of relatively flat shell (perhaps a piece of a conch shell from the Gulf of Mexico) that has been sawed bifacially to form a rectangle. It bears little polish and could be a blank (for a pendant?).

Relationships

This shell rectangle is from a Mesilla phase level in the Jornada region, but we could not determine distribution of similar ornaments in the rest of the Southwest.

TYPE: NOTCHED BONE (RASP)

Sample
1 from excavation

Dimensions (in mm)

	Mean
Length	35.0+
Width	8.0
Thickness	2.0
Depth of notch	3.0
Maximum notch width	1.5
Distance between notches	11.0

Form and Manufacturing Technique

This notched bone is made from a relatively flat splinter of long bone (deer?) that has been sawed bifacially into a long rectangle. One edge was notched by unifacial sawing.

Relationships

This fragment of notched bone occurred in an El Paso phase level; its distribution in the rest of the Southwest could not be determined.

TYPE: OTOLITH BEAD

The otolith, a fish earbone, may have been pierced to form a bead. It was recovered from an El Paso phase level.

TYPE: SHELL NOTCHED BRACELETS

Sample

3 fragments from excavation

Dimensions (in mm)

	Mean	Range
Maximum length	40.0+	
Maximum width	14.0	12.0-17.0
Thickness	1.8	1.20-3.0

Form and Manufacturing Technique

These fragments of shell notched bracelets are made from Glycymeris shell from the Pacific Ocean; it has been cut into long rectangles about 14 mm wide and notched about 10 mm apart. Two fragments have diagonal incisions across them.

Relationships

Shell notched bracelets occur in Ceramic times in the Jornada region and are common in the Hohokam culture of southern Arizona.

TYPE: CUT TURTLE SHELL

Two fragments of turtle shell from El Paso phase levels were sawed to make implements, but exactly what type of tool could not be determined.

TYPE: FLAT BOTTLE-SHAPED DISK BEADS

One specimen was recovered from an El Paso phase level. The notched half is 2.3 mm wide and has 1-mm diameter holes; the larger half is 3.5 mm wide and the whole bead is about 1 mm thick. Its distribution could not be determined.

Section 7

Perishable Artifacts

Originally, this nebulous category–perishable artifacts–and its descriptions probably included a wider variety of classes and types as well as more examples than our stone tools. Excavations of rockshelters in the Southwest, such as Chavez Cave (Cosgrove and Cosgrove 1947) and our very limited Tornillo Shelter, graphically illustrate what a large proportion of artifacts representing the ancient technology are perishable and normally do not appear as part of the excavated archaeological record. Furthermore, as the discussion of equally perishable foodstuffs indicates, what archaeologists have to work with to reconstruct ancient subsistence systems is even more limited and should make us humble about our conclusions and our reconstruction of ancient cultures from normal archaeological residuals. Moreover, as preserved remains from Tornillo show, the kinds of perishable artifacts utilized may be very much affected by the kind and seasonality of the occupations.

In our sample, only a couple of artifacts came from the Todsen Cave spring occupations. Most were from floors of Tornillo Shelter and reflected brief vegetal collecting through late-summer forays by task force groups. Our sample of 185 perishable artifacts thus is a most inadequate sample of even the Fresnal and Hueco phases, as a brief comparison with those from Chavez Cave decisively illustrates. However, our limited remains have one advantage over the Chavez materials: We do have some control over the chronology of our perishable remains. These data constitute a step toward determining changing types in an area where looting of shelters has destroyed much of the record (Fresnal perhaps excepted). Perhaps future findings and careful excavation of as yet undiscovered shelters may eventually fill this gap, but the prospect is not encouraging.

In describing those artifacts we have, which apparently came from summer forays in which a set of specialized plant-collecting tools was used, mainly from Tornillo Shelter, we shall use a different system of classification than we did for our lithic artifacts. The classes are as follows:

1. The elements used in making the collecting tools–quids, agave strands, coils, etc.
2. The kinds of string
3. The kinds of carry loops for plant remains, using different elements and string with different kinds of knots
4. The baskets, nets, and cloth (for bags) used to carry plants
5. A sandal of one of the persons who carried the plants and one of the weapons the person may have carried in his or her hand

The Elements

In the excavation of Tornillo Shelter (NMSU1541) we found a number of objects suggesting some string-making or weaving activities were being done during the occupants' brief summer foray in the shelter. Perhaps these were spur-of-the-moment activities designed to make objects to help with the collection of plant remains. Six sets of these elements occur in all levels.

1. *Quids.* Chewed yucca fibers that later could be rolled into yarn for cordage. They also were sucked for the nutritious juices.
2. *Yucca strands.* Range between 8 and 22 mm wide; the longest is almost 220 mm in length. These strands were used as carrying loops.
3. *Yucca coils.* While a few (4) are made of yucca strands as wide as the ones just mentioned, most (21) are very narrow (1 to 3 mm wide). They are wound into tight coils from 10 to 30 mm in diameter, and one of the strands might be as long as 100 mm. We believe these narrow strands may have served as stitching elements for sewing together the bundle foundations of coiled baskets.

Table IV-9. Temporal Relationships of Perishable Artifacts

	Tornillo, Zone D	Tornillo, Zone C	Tornillo, Zone B	LA5531, Zone J	LA5531, Zone F	LA5531, Zone ?J	Tornillo, Zone A1	LA5531, Zone D2	Tornillo, Zone A	LA5531, Zone D1	LA5531, Zone D	LA5531, Zone C	TOTAL
Pointed Whittled Stick					1		1	1			1	2	**6**
S-twisted Bast Yarn											1	1	**2**
Cotton Bundle											1	?	**1**
Split-stitch Bundle Foundation Basket									1		?		**1**
Woven 1/1 of Z-twisted Cotton Yarns											1	?	**1**
Cane Arrow Shaft									1		1		**2**
Z-twisted Cotton Yarn									1	1		?	**2**
Square Knot on S-twisted Yarn							1				1	2	**4**
Fishtail 2-warp Sandal		1											**1**
S-twisted 2 Z-twisted Yucca Yarn Cord		1			1	1							**3**
Chewed Quids	1	1		2	3		2	2				1	**12**
Lollipop Quid										1			**1**
Z-twisted Bast Yarn	3		2				1		2	?			**8**
Z-twisted Yucca Yarn	1		1	1	1	3		1	1	1			**10**
Bast Bundle	2	2	2				3		2				**11**
Yucca Granny Knot	1								1				**2**
Yucca Overhand Knot	3	1					2		1				**7**
Yucca Square Knot	11	15	5		1		4	1	4				**41**
Yucca Strands	11	7	6				5		2				**31**
Yucca Coils	6	3	7		1		7		1				**25**
Grass Bundles			4						1				**5**
Z-twisted 2 S-twisted Yucca Yarn Cord			1				3		1				**5**
Interlocking Loop Bundle Fdn. Basket			1						2				**3**
Cut Gourd	2	2	1		1		4						**10**
Yucca Loop S-twisted 2 Yarn Cord		1			1	1							**3**
Twine Bast Cloth	1												**1**
Yucca Slip Knot	1												**1**
TOTAL													**193**
PHASE	F				H			M		EP/DA			

KEY:

F = Fresnal EP = El Paso M = Mesilla
H = Hueco DA = Doña Ana

4. *Bast bundles.* In every floor of Tornillo, except zone A1, there were a couple of bundles of bast fibers (Indian hemp or milkweed). In zone Al the bundles were thinner and one of them was chewed. We believe these fibers were rolled to make bast yarn or cordage.
5. *Grass stalk bundles.* Four of the bundles of grass fibers occurred in zones Al and B of Tornillo,

zones that also contain basket fragments. We believe they may have served as the bundle foundations for the baskets being manufactured. Further support for this hypothesis is that the bundles are about 10 mm in diameter, roughly the same diameter as the bundle foundations of our baskets.

6. *Cotton bundle or quid.* In zone D, an El Paso level of Todsen Cave, we found one badly preserved ball, possibly chewed, that seemed to be of cotton. If so, it could have been the material made from this cotton yarn that subsequently was woven on a belt loom into the 1-over-1 cotton cloth we found in the same level.

Cordage

All the above elements (except the grass bundles) were twisted into yarns; two of these yarns often were twisted in opposite directions to create two-ply cord. (Cords with more plys are possible, of course, but we uncovered none.) The basic yarn twist may be of three types. Clockwise or S-twisted (following Underhill's 1944 Pueblo study) is yarn made by a right hander rolling wet fibers downward on the right thigh. Z-twisted or counter-clockwise yarn was made by a right hander rolling wet fibers upward on the right thigh. Tight Z-twisted is made by use of a spindle whorl. As Table IV-9 shows, we have these types of yarn in our sequential levels.

1. *Z-twisted yucca yarns.* Roughly 1 to 4 mm in diameter and not tightly twisted, having only 2 to 4 twists per centimeter. These probably start before the Archaic and diminish as S-twisted yarns increase.
2. *Z-twisted bast yarns.* Roughly 1 to 3 mm in diameter and slightly more tightly twisted than yucca yarns, with perhaps 3 to 5 twists per centimeter. They also occur throughout our sequence.
3. *S-twisted yucca yarn.* Roughly the same size as the Z-twisted yucca yarns, but more popular in Ceramic times throughout the Southwest.
4. *S-twisted bast yarns.* Present only in the El Paso level in Todsen Cave; they do not seem very popular here or in nearby Chavez Cave.
5. *S-twisted yucca cord of 2 Z-twisted yarns.* Only slightly thicker than the yarns–2 to 6 mm in diameter, with 3 to 5 twists per centimeter. They occur in our excavation in the Archaic, but elsewhere appear in Ceramic times.
6. *Z-twisted yucca cord of 2 S-twisted yarns.* These are the same size as the S-twisted cord, but one occurred later, in an El Paso level.
7. *S- and Z-twisted bast cord.* Although not in our excavation, they were found in other excavated sites in the Organ Mountains.
8. *Z-twisted cotton yarn.* All seem to be made by use of a spindle whorl. All are about 1 to 2 mm in diameter with many (10) twists per centimeter. They occurred only in our Ceramic levels, both in our excavations and in the rest of the Southwest.

Carry Loops and Snares

Most of our knots from Tornillo seem connected with carry loops and are made from yucca strands, although two of our yucca cords also may have been carry loops. The loops are 100 to 250 mm in diameter and are made on a single strand. Sometimes they are tied by a square knot to a second loop of another strand. However, two strands with double square knots on their ends suggest they were tied to yoke strands, often as much as 300 mm long, by square knots. Our experiments show that carrying loops such as these could have the central yoke strand across the back of the neck and shoulders, with the loops extending across the shoulders and under the arms, putting the bundle of yucca leaves in the loops on the chest. This arrangement would leave the hands free to carry something else.

In addition to these square knots, which we believe were part of carrying loops, two strands had an overhand knot and an overhand knot making a slip loop. Both of these could have been used as snares as well as carrying loops.

Baskets

Local collections, as well as the Cosgroves' early unstratified excavation (Cosgrove and Cosgrove 1947), abound with baskets of at least 10 types.

1. Interlocking stitch with bundle foundation
2. Interlocking stitch with half-rod foundation
3. Interlocking stitch with bundle foundation with split stitch
4. Half-rod foundation
5. Rod with lateral bundle foundation
6. One-rod foundation
7. Two-rod foundation and interlocking stitch with no bundle foundation
8. Bundle with rod foundation
9. Two lateral bundle foundations
10. Two-rod and bundle foundation

We uncovered only two of these types in our excavation–a small fragment of an uninterlocked stitch with bundle foundation, found in a Fresnal level and a Ceramic level, which also contained a fragment of a split-stitch bundle foundation basket. Two fragments–an interlocking stitch with bundle foundation and one-rod foundation–occurred in a nearby looter's hole in Tornillo Shelter, but their chronological position, like most perishable artifacts of this region, could not be ascertained.

The size of many of the basket types that lack good contexts seems much the same as the two types we uncovered from reliable contexts, as described below.

1. *Uninterlocked stitch bundle foundation.* About 400 mm in diameter and 150 mm deep, with a wide conical form, like that of a coolie hat. The bundles were 10 mm in diameter, the stitch 2 mm wide, and there were about 3.5 stitches per 25 mm. This type occurs in Middle Archaic times and may last into the Early Ceramic period as it does elsewhere in the Southwest (Dick 1965; Gumerman and Euler 1976). This type is very prevalent in the Big Bend (Shafer 1986) and the Coahuila area (Taylor 1966) in the Middle and Late Archaic.
2. *Split-stitch bundle foundation.* About 450 mm in diameter and 150 mm deep, with a shallow conical form. Bundles were 15 mm in diameter, with stitches about 4 mm wide and 3 stitches per 25 mm. This type of basket was found only in a Late Ceramic level, as it is everywhere, but the type might go back to the Late Archaic (Dick 1965), as it does in the Big Bend area of Texas (Shafer 1986).
3. *Interlocked stitch bundle foundation.* Fragments from the Tornillo looter's hole were estimated to be roughly the same size as the previously described basket. It occurs in San Pedro times in the Mogollon Rim (Dick 1965).

Textiles

Perhaps represented even more poorly are the textiles we recovered, which consist of a piece of a net, two fragments of cloth, and a partial worn-out sandal.

1. *Knotted net.* One small piece of cord of S-twisted of two-ply Z-twisted yucca yarns, about 40 mm long and 4 mm thick. This cord had two pieces, 4 mm long, of similar cord tied to it with an overhand knot. The two pieces were spaced about 15 mm apart, and we believe they are the cross pieces of a knotted net; however, the small spacing suggests the object might have been a bag. It occurred in a Late Archaic level. Similar nets occur in Late Archaic and Ceramic times, not only in the Southwest (Guernsey and Kidder 1921, plate 31c), but in many other areas.

2. *Twined cloth.* A tiny piece of loose-woven cloth, about 22 by 28 mm, was composed of S-twisted yarns of bast fibers about 1.5 mm in diameter. The warps were about 6 mm apart, while the (twined) wefts that twist over and under the warps were less than 4 mm apart. The looseness of weave, as well as the occurrence of the cloth in the zone D plant-collecting occupation (Fresnal, 1200 B.C.) of Tornillo suggest it might have been part of a bag. It is vaguely similar to bags from Chavez Cave (made of cords, not yarn), and similar bags occur in Basketmaker II and III sites in the Tsegi region of the Colorado Plateau (Guernsey and Kidder 1921; Kidder and Guernsey 1919), where they last until Pueblo IV times (Kidder 1932). They also occur with Cochise, Mogollon, and Hohokam remains in southern Arizona, southwestern New Mexico, and the Big Bend area of Texas. Adovasio (1977) and others have suggested this type of weaving may have been one of the earliest types in the New World.
3. *Plain (1/1) weave cotton cloth.* A small fragment, 15 by 35 mm, was made of Z-twisted tightly (spindle) wound cotton yarns with lengthwise warp elements slightly thicker (over 1 mm) than the woven weft elements. The warp elements are spaced fairly closely to one another (14 per 25 mm), while the woven weft elements are spaced very closely (about 20 per 25 mm). In their early exploration of caves in the Jornada region, the Cosgroves found no such cloth, but local collectors have some. Our sample is from an El Paso phase level, dating A.D. 1200, and we believe similar cloth from our region is of this late date. In the Anasazi area, such cloth does not appear until Pueblo times (A.D. 600), but it seems earlier in the Mogollon Rim (Dick 1965), appearing in the San Francisco phase (A.D. 400), while in the Hohokam, some appeared as early as the Salado phase (A.D. 600). This earlier occurrence perhaps reflects diffusion from Mesoamerica where this form of cloth goes back to at least 2000 B.C. Why it spread so late to the Southwest remains an unsolved problem.
4. *Fishtail 2-warp yucca sandal.* Sandals in the Jornada region have been uncovered by the thousands and belong to a variety of types (at least 12 have been described by the Cosgroves). These sandals are similar to ones from the Big Bend area, the Mogollon Rim, and the Anasazi area, but their types often are distinctive for each region. Our example–Cosgrove type 4a, 2-warp fishtail scutter-toe sandal–comes from a Fresnal level, about 1100 B.C., and is very diagnostic for the Jornada region (Cosgrove and Cosgrove 1947, figure 42).

   The fragment is about 180 mm by 100 mm. The warp is of two bundles of 14 whole yucca leaves, while the weft is of single paired leaves. The weft weave is wickerwork that started at the heel with the ends of the warp leaves protruding at the back to form a fishtail, as well as at the front to form a bent-over scuffer toe. The loops are made of long selected warp strands from either side of the distal end, while side straps are woven into the heel portion and are of thick, Z-twisted yarn. While typical of the Jornada region, this type also occurs in the Big Bend, but is rare or absent in Hohokam and Anasazi areas. Our data suggest it is of Middle and Late Archaic times, but more examples are needed from excavated contexts before we can determine how good a time marker it is.

Wooden Objects

In addition to perishable woven artifacts, we have some wooden objects worth noting.

1. *Cut gourd fragments.* Made of *Lagenaria spp.*, these occur in all our Middle and Late Archaic levels and last into Ceramic times. *Lagenaria* is an early import from Mesoamerica and served as a container for water and food, not as a foodstuff.
2. *Whittled (pointed) sticks.* Throughout all our Late Archaic and Ceramic levels we found sticks, from 4 to 24 mm in diameter, that had been whittled to points (by a flint chip?). Whether they were used as awls or weaving tools is difficult to determine, but wear on them suggests the latter.

3. *Cane arrow shafts.* One beat-up fragment (130 mm long) of the base of a cane arrow (15 mm in diameter) with a U-shaped neck, was found in an El Paso level. Many other arrow shafts, of a variety of types, have been excavated in the Jornada region; as elsewhere in the Southwest, they seem to appear late (after A.D. 700), attesting to the fact that the bow and arrow did not become popular until late in the sequence.

Section 8

The Ceramics of Todsen Cave

David V. Hill

This section describes the methods used to analyze the ceramic artifacts recovered during the excavation of Todsen Cave in 1986-87. Identification of the different ceramic types is used to create different seriation models in order to examine ceramic change through time. Next the kinds of vessels present at Todsen Cave are used to draw some tentative conclusions about the use of the site. Finally, a sample of sherds selected for petrographic analysis is used to identify potential sources of the Todsen Cave ceramics.

Methodolgy

Locational and attribute data were recorded for each sherd. Location was specified in terms of the unit, zone, and level from which each sherd was recovered (see tables IV-10 and IV-11). Classification of sherds recovered from zone F+ outside the dripline was recoded based on depth to relate them to corresponding levels in zones D2 and above. This was done in order to make the analysis of the zone F+ material comparable to that of sherds identified from zones inside the dripline.

All of the sherds were checked for refits to reduce the number of sherds so that each sherd or group of sherds represented a single vessel. This process also served as a check on the few sherds that had come from the preceramic zones in areas of rodent disturbance. In this way problems of postdepositional mixing within the rockshelter could be controlled as mixing would confound seriation studies.

We divided the ceramic attributes into three areas: formal, technological, and typological. Vessel forms were assigned based on the surface attributes of each sherd, such as the location of paint, polishing striations, or the side of the sherd with a smoother finish. This ranking allowed sherds to be classified as bowls or jars. Vessel forms derived from rim sherds were subdivided into large and small orifice categories using a series of ruled 1-cm circles as the standard of measurement. Vessels with an orifice of less than 10 cm were classed as small orifice vessels; large orifice vessels were more than 10 cm. Rim sherds also were used to identify inverted restricted vessels, known as "tecomates," or seed jars.

Ceramic Typology

Brownware. The majority of the ceramics from Todsen Cave were brownwares. Although a few of these sherds could represent undecorated portions of painted brownware or smooth lower sections of corrugated jars, all of the plain-surfaced sherds were treated similarly. Previous studies of brownware ceramics in the Jornada Mogollon region have identified three brownware types: Alma Plain, Jornada Brown, and El Paso Brown.

The first of these types to be classified was Alma Plain. The original description (Haury 1936) is based on materials from Mogollon Village on the San Francisco River. This type is described as having a polished surface on a coarse paste, tempered with an unidentified heterogeneous material. Various forms of bowls and jars of this type are known. Alma Plain-like ceramics from the Jornada Mogollon area are distinguished by a light-colored paste, a smooth, polished surface, and a relatively fine temper particle size (O'Laughlin 1985).

Jornada Brown first was identified at LA2000 in the Sacramento Mountains (Jennings 1940). Jornada Brown ceramics have a finer temper particle size and a polished surface, unlike the El Paso Polychrome recovered from the same site, which had a coarse temper and was not polished.

El Paso Brown was described first at Los Tules, a large multicomponent site on the Rio Grande, south of Mesilla. El Paso Brown is described as having large and profuse temper particles in a brown paste and surface smoothing that varies in degree (Lehmer 1948). More recently, plain-surfaced body sherds have been classified as unspecific brownware (UB) since such sherds could have been derived from unpainted portions of El Paso Polychrome vessels. The use of an unspecific brownware category allows only plainware rim sherds to be classified typologically.

Table IV-10. Location of Sherds in Todsen Cave

	TOTAL	OTHER	K1	K	J1	J	G	F	EJ	E	D2	D1	D	C	B	A
SURFACE FINISH																
Historic Plainware (3J)	3												1J		2J	
Smudged Interior (1B)	1															1B
Polished (8B, 79J)	87			2J	2J	1J	1J	1J	2B, 10J	1J	3B, 29J	1B, 8J	1B, 23J		1B	2J
Slightly Polished (8B, 96J)	104			1J	3J	2B, 3J		1J	6J		2B, 24J	3B, 10J	1B, 37J	2J	5J	4J
Plain Surface (10B, 269J)	279	1B, 5J		1J		2J	1J	3J	1B, 23J		2B, 42J	3B, 58J	2B, 112J	1B, 10J	6J	6J
SURFACE TEXTURE																
Smooth Interior (2J)	2										1J		1J			
Corrugated/Smudged Interior (2J)	2														1J	
Polished Corrugated (5J)	5										1J	1J	3J			
Obliterated Corrugated (8J)	8										1J	1J	6J			
Indented corrugated (6J)	6											3J	3J			
POTTERY TYPES																
Mexican Glaze on Orange (1J)	1													2J		
El Paso Bichrome Red (1J)	1												1J			
El Paso Polychrome (3J)	3											1J	2J			
El Paso Bichrome Black (4J)	4										2J	1J	1J			
Mimbres Black/White (6B)	6	1B									3B	1B	1B			
Incised Plainware (2J)	2										1J		1J	1B		
Mogollon Whiteware (11B, 1J)	12										1B	3B, 1J	7B			
Three Circle Red/White (2B)	2											1B	1B			
San Francisco Red (11B, 20J)	31		1J			2J			1B, 1J		3B, 7J	5B, 4J	2B, 5J			
TOTALS (57B, 501J)	**558**		**DOWNSLOPE**			**MESILLA**					**DOÑA ANA/ EL PASO**			**APACHE**		

KEY:
B = Bowl
J = Jar

Much of the variation recognized in the three brownware types in terms of paste color and temper can be attributable to variation in the local materials from which the ceramics are made. Differences in temper particle size and composition also can reflect vessel function since different classes of pottery have different sizes or types of temper (Mills 1984; Hill 1990a). Surface treatments, such as the degree of polishing, are also related functionally in that polishing makes the ceramic pastes less porous. This practice, however, is more under the control of the potter than is the composition of the raw materials.

In order to examine the possible relationship between temper size and degree of surface finish, undecorated

brownwares were classified by the quality of the surface. Vessel surfaces were categorized as *polished* if they had completely smooth burnished surfaces; *slightly polished* if the polishing striations were visible as uneven, often overlapping streaks; or *plain* if the surface lacked smoothing beyond the forming and scraping stage of construction.

Table IV-11. Todsen Cave Ceramics Lacking Zone Assignment

SEQUENCE	LEVEL	PLAIN SURFACE	SLIGHTLY POLISHED	POLISHED	UNIDENTIFIED BLACK/WHITE
Site Surface		1			
Wall Scraping					1
S3/W4	Surface	2			
N3/W4	Surface	1			
N1/W1	Surface	1			
N1/W5	1	1			
N1/W1	2			2	
N2/E0	2	1			
N1/W1	4		1		
N2/W4	4			2	
S1/W3	4	1			
N1/W1	7			3	
N1/W1	12	2		2	

NOTE: All sherds are from jars except one polished bowl sherd from N2/W4.

Temper particle size was estimated using an American-Canadian stratigraphic grain size card (Hill 1987). A contingency table comparing temper size and surface treatment of jar sherds from the major ceramic-producing zones was used to reject the null hypothesis, that is, that there is no relationship between surface treatment and temper particle size. Jar sherds were selected for this analysis because of their greater number in the ceramic sample and as a way of avoiding problems in drawing from more than one use category.

The null hypothesis was rejected with a Chi-square value of 52.512, with 8 degrees of freedom with a significance level of 1.34026 E-8. Thus, some sort of relationship does exist between surface treatment and temper particle size. But what is the nature of this relationship? Petrographic analysis of brownwares from Todsen Cave has shown that the same type of crushed syenitic rock is found in the majority of the brownwares, regardless of surface treatment. Consequently, at least some of the differences in surface treatment recognized by previous researchers may not reflect the importation of ceramics. Instead, differences in paste and temper within Jornada Mogollon assemblages may be related to variations in the function of the different kinds of jar forms–the use of ceramic cooking vessels that are less smoothed and that have a larger temper particle size, or the use of smooth-surfaced, fine-paste brownwares for storage and transport. A fine-tempered, highly polished ceramic, identified as Alma Plain, has been recovered from sites in association with the coarser El Paso Brown (Mera 1943; Schaafsma 1974; Morenon and Hays 1984; O'Laughlin 1985). Rather than representing a mixing of occupations, this association of coarse and fine brownwares may reflect technological variation. Unfortunately, the small sample size of brownware rim sherds from Todsen Cave did not allow such functional divisions to be examined through the comparison of rim morphology and temper particle size.

A small number of sherds were different enough from the other brownwares to be described separately. A single bowl sherd recovered from zone D1 had a smudged interior. The paste, however, appeared to be more like the other plain brownwares than like the fine homogeneous paste of Reserve Smudged (Rinaldo and Bluhm 1956).

One class of plain-surface brownware ceramics differed from the others in that it had a fine temper particle size and a light tan silty paste with a smooth surface that lacked polishing striations. One of these sherds, examined petro-

graphically, was sand tempered. While little is known regarding the range of variation in the temper of prehistoric brownwares from southern New Mexico, Chihuahua, and West Texas, most indigenous ceramics of the historic period are sand tempered. Plain sand-tempered ceramics have been recovered from contexts dating from the late seventeenth century to the nineteenth century, including early colonial settlements, military posts, and a Butterfield Stage line station (Hill 1986, 1990b; Tice 1986).

Surface-Textured Ceramics. The greatest variation in unpainted ceramics was observed in corrugated jar sherds. These variations have been observed in large collections of corrugated ceramics from the Mimbres Valley (Cosgrove and Cosgrove 1932). Indented corrugations often were obliterated when the vessel's surface was smoothed by the potter's hand or by a polishing stone while the paste was still moist. One indented corrugated sherd from zone B of Todsen Cave has a grayish brown paste and a highly burnished smudged interior. This sherd most resembles Reserve Indented Corrugated Smudged interior variety (Rinaldo and Bluhm 1956).

A single rim sherd from a tecomate was recovered from zone D1. Extending away from the orifice of this sherd were striations seemingly made by scraping the moist clay surface with a corn cob. Similar ceramics recovered from the early Mesilla phase occupations of the Brazito North site and the Hatch site had been classified as Alma Scored (Schaafsma 1974; O'Laughlin 1985). When examined petrographically, this sherd contained crushed syenitic rock.

Two incised sherds with a light tan paste and fine crushed-rock temper were recovered. One sherd came from zone D2, the other from zone D just below the surface. The surface texture consists of 1-mm-wide, shallow channels oriented parallel to one another. Another incised sherd, also from zone D, had a black, possibly smudged exterior surface and dark core and had been incised, the incisions polished over until the lines had been partially obliterated.

Painted Ceramics. The most common decorated type in the collection from Todsen Cave is San Francisco Red (Haury 1936). Sherds of this type, represented by both bowls and jars, have a maroon slip. All of the sherds were tempered with crushed igneous rock. Two sherds, found within 10 cm of the surface in zone D, had thinner red slips with a coarser temper size than the other examples of San Francisco Red. These sherds may represent examples of Jornada Red, a red slipped type thought to have been manufactured after the traditional terminal date of San Francisco Red at about A.D. 1000 (Anyon and LeBlanc 1984) in the Jornada Mogollon area (Bussey et al. 1976).

Mimbres Whiteware was not as common in the collection as was San Francisco Red. This class of ceramics was identified by a brownish gray paste with a white slip that was tempered with crushed igneous rock. On those specimens with paint, polishing was confined to the painted areas (Sudar-Laumbach 1982). Because of the small size of the sherds, the different design styles identified as chronologically important in Mimbres Whiteware could not be used. Instead, sherds with very fine parallel lines were assigned to a Mimbres Black-on-White category. All of the others were recorded as undifferentiated Mimbres Whiteware.

Two sherds that had wide lines of oxidized red-orange paint were classified as Three Circle Red-on-White. The reddish color, however, may have been caused by problems in firing the vessels or later oxidation of the sherds.

A single whiteware sherd that did not match the attributes of the Mimbres Whiteware sherds also was recovered. The sherd was recovered during cleaning of the wall of the trench originally excavated by Beckett and O'Laughlin, so that the associated zone is unknown. The sherd, from a jar, has a light gray paste with a dark gray core and is tempered using crushed rhyolitic tuff. The white interior and exterior surfaces appear to be the result of fine clay particles brought to the surface by floating rather than the result of a true slip. Both the interior and exterior surfaces showed polishing striations, and some of the temper particles protrude to the surface. The decoration consists of a series of broad curved lines executed in a mineral-based pigment.

The decorated types within the category of El Paso Brownware, El Paso Bichrome (both black and red), and El Paso Polychrome were represented poorly in the collection. Because of the small size of the sherds, no complete design elements could be recognized. With the exception of one sherd of El Paso Bichrome (red), none of the decorated brownware sherds showed evidence of polishing, and the polish on the bichrome sherd was uneven.

Two sherds from a nineteenth-century Mexican glaze vessel were recovered from zone C (Rex Gerald, personal communication 1988). These sherds had a fine orange paste and black glaze paint, and the interior and exterior surfaces were covered with a clear glaze. Although probably from the same vessel, the two sherds were too small to allow identification of the vessel form.

Modified Sherds. Three sherds showed evidence of reuse after breakage. One plain-surface sherd of a jar from zone D1 had an edge that showed evidence of grinding that resulted in pronounced striations parallel to the surface. This grinding created a wedge-shaped edge. Along the wedge-shaped working edge of the tool small spalls later were removed through use. The tool appears to have been broken along one edge. Worked sherds with edge abrasion and spalling have been reported previously from the Jornada area (Lehmer 1948; Miller 1989). These sherds are presumed to have been used to excavate or remove the fill or food from hearths. The current specimen has a maximum length along the working edge of 4.6 cm and a maximum width of 3 cm.

Another plainware jar sherd from zone D1 has an interior hematitic stain that suggests the sherd's use as a paint cup. Ground stone artifacts with similar stains indicating use in pigment preparation were recovered from Todsen Cave, but none were found in zone D1. Sherds reused as paint cups have not been well reported in the region. However, both brownware and Mimbres Style I (Mangus Black-on-White) sherds with hematitic stains on their interiors have been recovered from a pit structure in the community of Tortugas, New Mexico (David Batcho, personal communication 1989). Undoubtedly, more sherds with behaviorally significant adhesions would be recovered if ceramic collections were examined for such occurrences prior to washing.

A third modified plainware sherd also was recovered from zone D1. This sherd has an engraved design on its interior that consists of a series of opposed lines pendant from a single central line. The opposed lines are paired and set at an angle approximately 30° to the center line. The engraving was executed using a thin, sharp-edged tool, most likely a flake. Whether this design is supposed to be representational, perhaps a plant stalk, or abstract is unknown.

Ceramic Stratigraphy and Seriation

In order to examine changes through stratigraphic time within Todsen Cave, we needed to assess the quality of the relationship between the defined zones. Evidence of disturbance in the form of rodent burrows was commonly visible in profiles, and all of the ceramics recovered from below zone πJ came from burrow fill. Likewise, the presence of historic ceramics in otherwise prehistoric zones indicates some stratigraphic mixing occurred. Undoubtedly, some prehistoric and historic activities not discernible to the excavators may have contributed to redeposition of sherds. Historic glass was observed in the upper three zones. Though no complete counts were made of the glass from the first two zones, estimates were generated by counting selected sample bags. Zone A produced more than 200 glass sherds and zone B more than 50. Zone C, however, contained only six. The distribution of glass sherds within these three zones indicates zones A and B, at least, and some portions of zone C were disturbed during the historic period. None of the lower zones contained historic materials except possibly historic native-made pottery. To try to understand the degree to which mixing occurred, all of the ceramics were checked for conjoinability to see if any portion of the same vessel could be located in one or more zones or excavation levels.

The few sherds that could be refitted (see Table IV-13) came from individual excavation units within single zones. None of the conjoinable sherds were separated by more than a few centimeters either horizontally or vertically. This proximity suggests that at least portions of the Ceramic period zone, both inside and outside of the dripline, have remained undisturbed by rodent burrowing or other conditions. The breakup of the sherds that do refit may be attributable to trampling or ground pressure. Given this admitted limited evidence of stratigraphic integrity, seriation studies can be conducted meaningfully.

The limited number of refits in the ceramic collection most likely is the result of two processes: the removal of broken vessels as trash, and the retention of the sherds for later reuse elsewhere. This suggests Ceramic period occupation of Todsen Cave was of sufficient duration and by enough individuals for refuse to accumulate to the point of needing removal.

The earliest Ceramic period occupation of Todsen Cave occurred during the early Mesilla phase. Ceramic types associated with this period consist of Alma Plain (polished plain), El Paso Brown (slightly polished, plain surface), and San Francisco Red. While all of these types persist into later periods (Anyon and LeBlanc 1984), they are present without later-occurring ceramic types in zone J. The earliest dates for this ceramic complex come from a series of sites near Hatch, New Mexico (Morenon and Hays 1984). PA 2 produced a suite of radiocarbon dates between 1690 ± 70 and 1260 ± 70 B.P. PA 8 had dates between 1750 ± 60 and 1580 ± 70 B.P. These dates indicate ceramic production was occurring in the area by at least A.D. 250 to 300. Another series of early dates associated with the presence of

Alma Plain and El Paso Brown comes from excavations at Fort Bliss, Texas (Kaufman and Batcho 1988). Site 1132 had a hutlike structure associated with the ceramics that produced four dates, the weighted average of which falls between A.D. 131 and 380.

Table IV-12. Relationship of Temper Size to Surface Treatment

TEMPER SIZE*	PLAIN	SLIGHTLY POLISHED	POLISHED
177-250	6	1	3
251-350	8	9	20
351-500	116	46	41
501-710	123	30	16
711-1000	13	1	1

**Measurements are in microns.*

Several other sites in the Jornada Mogollon area manifest early Mesilla phase occupations and associated ceramic assemblages. Sites that make up the Brazito and Hill ceramic complexes fall within this time range (O'Laughlin 1985). Likewise, some of the pithouse occupations at Los Tules, Hatch, and Rincon also produced assemblages comprised of Alma Plain, El Paso Brown, and San Francisco Red (Lehmer 1948; Hammack 1962; Schaafsma 1974).

Later occupations of Todsen Cave are more difficult to distinguish temporally because of the lack of significant changes in the type frequencies as well as the low representation of temporally distinct types in the upper zones. The pottery types that make up early Mesilla phase ceramic assemblages also are represented in zones D2 and above. The persistence of this earlier ceramic complex into later times has been documented through stratigraphic excavations in the Mimbres Valley, where Alma Plain and probably San Francisco Red occur with Mimbres Whitewares (Anyon and LeBlanc 1984). El Paso Bichromes and Polychrome occur sporadically as trade items in these same Mimbres Valley assemblages.

Ceramic assemblages diagnostic of the Doña Ana phase contain El Paso Brown, El Paso Bichromes, and El Paso Polychrome as indigenous types and Mimbres Black-on-White, San Francisco Red, Alma Plain, and Mimbres Corrugated as intrusives (Lehmer 1948). Thus, zones D2 and above could be considered as representing a series of Doña Ana or late Mesilla phase occupations.

Little evidence of an El Paso phase occupation is present at Todsen Cave, an observation based largely on negative evidence. El Paso phase occupations are characterized ceramically by the presence of El Paso Polychrome along with a number of important wares, including St. Johns Polychrome, various Casas Grandes-like Polychromes, and Chupadero Black-on-White (Lehmer 1948; Gerald 1988). These imported ceramics all date to after A.D. 1150. None of these types of imported ceramics or any others that could be associated with an El Paso phase occupation were observed in the collection. The lack of exotic ceramics in the Todsen Cave assemblage also could be the result of the lack of imported types, obtained from more distant productive sources than the earlier Mimbres Whitewares at the site, the occupation of which most likely was of a seasonal nature.

An attempt to divide Ceramic period occupations more finely was made through examination of changes in rim morphology. Changes in rim finish through time were noted first by Lehmer (1948) and most likely were a reflection of his earlier work with Middle Missouri ceramics. More recent studies using rim form changes as a seriation technique have included the use of independent dating of sites where rim sherds were collected to create a typology of rim shapes (Whalen 1978, 1980) and the standardization of measurements of rim thickness (West 1982).

More recently, studies using rim morphology measurements for seriation purposes have divided ceramics into functional classes. This practice has shown that variation in rim measurement is related to changes in morphology and thus presumably the function of ceramics through time (Seaman and Mills 1985).

In order to examine changes in functional classes through time, bowl and jar rim sherds of more than 3 cm along the lip were matched to a series of size-graded arcs. This allowed jars to be placed into categories: large (more than 10 cm) and small (10 cm or less). No bowl sherds were large enough to measure. While the method of fitting sherds

to curves has come under some criticism as somewhat subjective, given the gross categories and size of the rim sherds, these estimates should be reproducible.

Table IV-13. Conjoinable Sherds from Todsen Cave

SPECIMEN	UNIT	LEVEL	OTHER PROVENIENCE INFORMATION
15590	N2/W4		Zone κJ, 123 cm BSQD
10689	N2/W4	6	Zone F+, 54 cm BSQD
10318	S3/W1	6	Zone D, 76 cm BSQD
10317	S3/W1	6	Zone D, 84 cm BSQD
14304	S2/W2	7	Zone D2, S1.88/W2.28
14271	S2/W2	7	Zone D2, S1.73/W2.40
14360	S2/W2	7	Zone D2, Screen Bag
14273	S2/W2	7	Zone D2, S1.79/W2.34

KEY: BSQD = Below Square Datum

All rim sherds large enough for vessel form to be estimated were also illustrated by zone (see Figure IV-41). Wide-orifice, straight-rimmed jar forms correspond to the shapes represented for the Brazito and Hill ceramic complex vessel forms 4, 5, and 6. Narrow-necked jar forms correspond to form 7 (O'Laughlin 1985:63). Only three sherds in the rim sherd sample, all from brownware jars, are from everted rim jars; one of these, 19868 from zone D2, is tempered using sand and could have been intrusive from the historic period. The presence of jars with everted rims may occur as early as Mogollon I and also may increase in frequency through time and be most prevalent in El Paso Polychrome (Whalen 1978; Seaman and Mills 1985). El Paso Polychrome is represented by only two sherds in the Todsen Cave assemblage, and neither is a rim. The low frequency of everted jar rims in zones D2 and above, and the greater amount of direct rim vessels, indicate these deposits reflect occupations dating to the late Mesilla or Doña Ana phase.

One aspect of rim sherds that has received little attention is lip shape. While most of the rims have parallel side walls and a rounded lip, a few have slightly flattened to squared lips. The presence of squared lips on ceramic vessels has been documented as occurring in Mesilla Valley assemblages thought to date prior to A.D. 850 (O'Laughlin 1985). The presence of squared rims in zones D2 and above indicates this rim form continues into later times as well. However, the difference in lip forms is unusual and may be indicative of a local stylistic variation.

In summary, based on the presence of an early ceramic complex consisting of El Paso Brown, Alma Plain, and San Francisco Red, it appears that Todsen Cave was used during the early Mesilla phase. Use of the site continued into the Doña Ana phase with the inclusion of Mimbres Whiteware, El Paso Bichromes, and El Paso Polychrome, corrugated jars, and the presence of everted rims. If an El Paso phase occupation is present, it left no trace ceramically.

Petrographic Analysis

Little is known of the range of mobility and exchange that occurred throughout the Jornada Mogollon region during the Ceramic period occupation. The approach most commonly taken towards the interpretation of interregional and intraregional contact has been through petrographic analysis.

The most widely analyzed ceramic type has been Mimbres Black-on-White (Elizabeth Garrett, personal communication 1989; Hill 1989b; Reily 1974; Rugge 1976, 1977, 1985, 1988). These studies have shown that while Mimbres Black-on-White has a homogeneous temper in ceramics recovered from the Mimbres Valley, sherds analyzed from the Jornada Mogollon area are tempered using rock types not common east of the Rio Grande. Considerable compositional diversity exists in the types of temper found in Mimbres Black-on-White, even in assemblages from the same site in the Jornada Mogollon area. This suggests Mogollon Whitewares probably were not manufactured in the Jornada Mo-

gollon area and their presence represents evidence of regional mobility and exchange with peoples living west of the Rio Grande.

Some petrographic studies have been conducted of El Paso Brownware (MacCurdy ms.; Garrett 1987; Hill 1988, 1989a, Rugge 1985). The rock types used as temper in the brownware ceramics appear to have been derived from sources closer to the sites from which the sherds were recovered than is the temper found in Mimbres Black-on-White.

Petrographic analysis of ceramics from Todsen Cave was undertaken in order to examine changes in the production sources of ceramics through time and the relationship of the composition of several decorated types to that of contemporary brownwares.

A total of 24 sherds was analyzed. The sample included all brownware rim sherds, one San Francisco Red sherd, and one unidentified black-on-white sherd (see Table IV-14). Rim sherds were used for the analysis since some of the regional decorated ceramic types cannot always be identified from body sherds. Also, different types of temper are often used in the manufacture of diverse functional classes of vessels (Arnold 1985). A body sherd from an unidentified black-on-white jar also was analyzed in an attempt to place its origin and to provide comparative information for future researchers.

Table IV-14. Todsen Cave Petrography Sample

COMPOSITIONAL GROUP	CATALOG NUMBER	ZONE	VESSEL FORM	CERAMIC TYPE
1	23169	D	Wide Orifice Jar	Plain
1	23344	πJ	Wide Orifice jar	Plain
1	15668	D1	Jar	Plain
1	14303	D2	Narrow Neck Jar	Plain
1	9748	D1	Narrow Neck Jar	Plain
1	15816	D	Wide Orifice Jar	Plain
1	23173	D	Narrow Neck Jar	Slightly Polished
1	16986	D1	Tecomate	Corncob Scraped?
1	11799	D1	Bowl	Plain
1	15590	πJ	Jar	Plain
1	22685	D1	Wide Orifice Jar	Plain
1	10008	D	Jar	Plain
1	16206	πJ	Jar	San Francisco Red
1	22153	D2	Jar	El Paso Bichrome Black
1	10689	D2	Narrow Neck Jar	Plain
1	11915	J	Jar	Polished
1	13446	D1	Jar	Plain
1	9745	D2	Wide Orifice Jar	Plain
1	9665	D1	Bowl	Plain
2	10084	D	Jar	Plain
3	11549	D2	Bowl	Plain
4	16777	D	Jar	Plain
5	19868	D2	Wide Orifice Jar	Plain
6	13165	Wall Scraping	Jar	Unidentified B/W

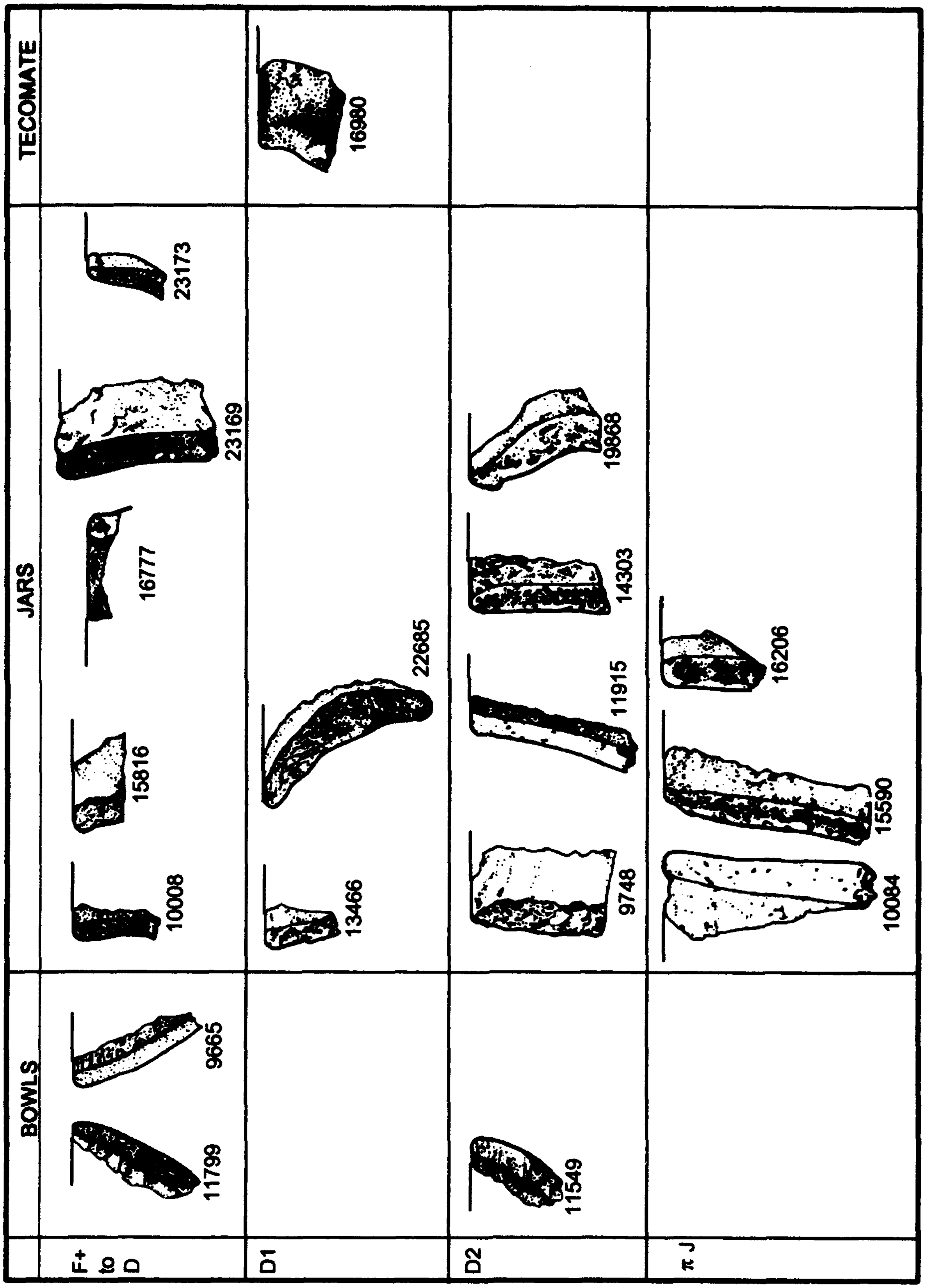


Figure IV-41. Selected Rim Sherds from Todsen Cave

Each sample was counted at 1-mm intervals for 100 points each. This number of points was chosen because some of the samples were quite small and fewer points could be counted in order to assure comparability between the specimens. Each mineral grain and rock fragment was counted, and X and Y measurements made of the temper particle recorded. These procedures permitted the identification of six different types of temper within the ceramics chosen for analysis.

Table IV-15. Petrographic Analysis of Todsen Cave Ceramics: Point Count Data

SAMPLE	ORTHOCLASE	PLAGIOCLASE	SANIDINE	MICROCLINE	QUARTZ	BIOTITE	ROCK FRAGMENTS	VOID	PASTE
15816	17	2			1		4	6	69
16206	16				2		4	5	73
14303	19	1	1				4	3	71
10689	25							1	70
11915	11	1						1	77
15590	18	1					8	6	67
23344	14	1	2				11	2	70
16777	17	6		2			1	5	66
10008	21	2					2	2	73
22685	25							2	73
9748	24				3		3	3	67
15668	15	1	2	1	1		6		72
11799	15						2	2	81
9665	11						2	3	84
23173	27	1					9	3	60
9745	24						6	14	56
16986	23				3		5	3	66
23169	14	2	3	1			3	1	76
10084	6	3		1			6	4	80
11549	12				1	1	7	3	75
13163	1		3				20	1	75
22153	23							6	71
19868	13				8		4	2	72

The largest compositional group, consisting of 19 sherds, includes not only brownware, but El Paso Bichrome: Black variety and San Francisco Red. Orthoclase is the primary mineral occurring as isolated grains and as the dominant constituent of the coarsely crystalline to porphyritic rock fragments. Virtually all of the orthoclase contained perthritic intergrowths of the ribbon type although some patch type perthites were also observed. Samples 13466, 15668, and 23169 contained isolated microcline grains. Sparse oligoclase grains were observed in nine of the samples. Rare

sanidine was recognized through optic axis determinations. All of the feldspars were moderately to highly altered to clay minerals and sericite. In a few grains this alteration was so severe the optical characteristics of the feldspars were virtually obscured. A light dusting of hematite was observed in the rock fragments, and this most likely is due to the alteration of ferromagnesian minerals in the source rock. For example, sample 13466 contains pleiochroic brown hornblende altered along its margins to brown biotite and hematite.

Table IV-16. Petrographic Analysis of Todsen Cave Ceramics: Measurement Data (in square millimeters)

SAMPLE	ORTHOCLASE		PLAGIOCLASE		SANIDINE		MICROCLINE		QUARTZ		BIOTITE		ROCK FRAGMENTS	
	A	SD	A	SD	A	SD	A	SD	A	SD	A	SD	A	SD
15816	0.54	0.29	9	0.29					(.6x.23)				0.2	0.4
16206	0.6	0.45							0.12	0.38			0.36	0.46
14303	0.95	0.63	(.45x.53)		(.32x.53)				(.37x.32)				0.35	0.72
10689	0.75	0.53											0.28	0.68
11915	0.45	0.21	(.9x.63)										1.11	0.67
15590	0.66	0.42	(1.1x.6)										0.68	0.87
23344	1.1	0.56	(1.32x.92)		0.17	0.47							1.5	1.1
13466	0.63	0.5	(.31x.22)				0.12	0.31					0.2	0.43
16777	0.46	0.29	0.35	0.58			0.04	0.11					0.24	0.47
10008	0.48	0.26											0.11	0.35
22685	0.75	0.35												
9748	0.75	0.41							0.11	0.3			0.85	0.92
15668	1	0.56	(.35x.25)		0.16	0.5	(1.05x.56)		(.43x.32)				0.63	0.92
11799	1.01	0.58											0.23	0.62
9665	0.6	0.35											0.11	0.3
23173	0.88	0.52	(.9x.83)										0.59	0.85
9745	0.73	0.45											0.32	0.65
16986	0.76	0.47							0.1	0.31			0.3	0.63
23169	0.95	0.63	0.16	0.42	0.29	0.64	(.6x.89)						0.33	0.7
10084	0.63	0.34	0.2	0.25			(.63x.45)						1.6	0.6
11549	0.65	0.25							0.18	0.4	(.1x.98)		0.86	0.8
13163	(1.1x.73)				0.1	0.31							0.81	0.41
22153	0.66	0.29												
19868	0.42	0.34							0.24	0.21			0.2	0.34

All of the rock fragments and isolated mineral grains are angular to subangular in shape, often breaking along crystalline boundaries. This angularity, along with the degree of alteration of the mineral suite present, suggests ce-

ramic temper was obtained at outcrop locations at altered zones or possibly as detrital material. Given the orthoclase-rich nature of the rocks crushed as tempering material, they are classifiable as syenites.

The other types of temper were recognized only in single specimens. Sample 10084, a plain-surfaced jar sherd from zone D, contains a mixture of several rock types. The predominant rock type contains orthoclase and oligoclase, both of which were altered to clay minerals and sericite. Much of the oligoclase has completely corroded centers. Patch and ribbon perthites were common. Also present in the paste of this sherd were angular dark brownish gray grains with an aphanitic groundmass containing oligoclase with a trachyitic texture. While one of these grains contained pleiochroic blue-green pyroxene, most of the iron-rich minerals had been altered to brown biotite and hematite. The degree of weathering and alteration, as well as the variation in rock types, suggests the use of a volcanic breccia as the source of the temper.

Sample 11549 is tempered using a porphyritic rock, the groundmass composed of mostly orthoclase, although some oligoclase is present as well; both minerals have been altered almost completely to clay mineral and sericite, as have most of the feldspars. These fragments have a light dusting of hematite from the alteration of ferromagnesian minerals. A few grains of brown hornblende are present with corroded margins altered to hematite. Sparse pleiochroic yellow to pink epidote also is present. This sample appears to be from a highly altered source of monzonitic porphyry.

Although similar in many respects to the syenitic rock found in most of the Todsen Cave sherds, in terms of the presence of altered orthoclase in a porphyritic groundmass, sample 16777 also contains a considerable amount of oligoclase. The orthoclase and microcline contain some pertritic intergrowths of the ribbon type. This sample may be a variation of the syenitic temper that contains more plagioclase, thus classifying the rock used as tempering for this specimen as a monzonite.

Sample 19868 has an unusual uniform light brown paste that is free from inclusions and lacks the mottled appearance of the other sherds. The mineral grains and rock fragments are subrounded to rounded. This sherd has the smallest size of temper particles of any of the sherds in the petrographic sample. Compositionally, three types of rock fragments are present. One type has a cryptocrystalline groundmass with porphyritic orthoclase often altered to clay minerals. A second type of rock, most likely related to the previous porphyritic type, consists of the groundmass alone and is made up of altered orthoclase. One rounded basalt fragment was observed, as were numerous rounded quartz sand grains. The temper used in the sherd is sand, perhaps derived from a source near the outcrops of the crushed syenitic rocks.

The only sand-tempered ceramics analyzed petrographically in southern New Mexico, West Texas, and northern Chihuahua are attributable to the historic aboriginal tradition (Hill 1988, 1990b). As little is known about compositional variation in brownware ceramics, this sherd could represent either an example of historic plainware or an undescribed variety of prehistoric brownware.

The temper in the unidentified black-on-white sherd, sample 13163, contains predominantly devitrified glass fragments. The most common mineral is sanidine contained porphyritically. The sanidine and devitrified glass fragments have a weathered appearance and often are altered to clay minerals. A few fragments of chalcedony also are present. One single basalt grain containing trachyitic laths of oligoclase also was observed. The temper of the specimen is pyroclastic in nature and most likely was derived from a rhyolitic tuff. The chalcedony represents a late-stage alteration of the rhyolite.

Sources of Ceramic Temper

Petrographic analysis, it must be realized, is a technique that samples the variation in a larger object, in this case complete vessels, and tries to relate the observed materials back to the outcrop sources that can be variable compositionally themselves. Therefore, the relationship between the sample and the larger body and source is not always direct. Although some suggestions can be made based on the ubiquity of some of the tempering agents used in the petrography sample from Todsen Cave and their availability in the area, other types of temper are less easily assigned to a specific source.

The predominant types of temper recognized in the analysis are syenite and monzonite. The nearest syenitic rocks form the central core of the Doña Ana Mountains (Dunham 1935:246) and the majority of the Organ Mountains (Seager 1981). In the Organ Mountains, rocks relating to the Organ batholith range in composition from

monzodiorite10 to syenite to granite (Seager 1981:58-59). This range of variation, also derived from petrographic analysis, encompasses not only the sherds tempered with crushed syenitic rock but also samples 11549 and 16777. The sand used in tempering sample 19868 may have been derived from one of these sources.

Sample 10084, which was tempered using a volcanic breccia or volcaniclastic deposit, is more difficult to assign to a particular source. Sedimentary beds containing conglomeratic igneous materials are known from the Palm Park, Thurman, and Bell Top formations (Kelly and Silver 1952; Seager and Hawley 1973; Clemons 1976). All of these formations outcrop in central Doña Ana County and are complex compositionally, with the individual volcaniclastic units containing rock types from a number of sources.

The temper used in Sample 13163, the unidentified black-on-white sherd, was derived from a rhyolitic flow or tuff. Such flows and tuffs make up much of the Tertiary rocks of southwestern New Mexico (Elston 1976), thus no single source can be identified for this sherd.

Implications for Archaeology

The ceramics within the petrographic sample crosscut both variations in surface treatment and zone assignment. The majority of the brownware sherds as well as the samples of San Francisco Red and El Paso Bichrome: Black variety were tempered using materials most likely derived from the Doña Ana or Organ Mountains. This indicates that the makers of some of the ceramics lived east of the Rio Grande, at least seasonally, a pattern that appears to have continued throughout the Ceramic period occupation. Todsen Cave thus may have been used annually as a base camp or field shelter by peoples using but not residing on the west side of the Rio Grande. The utilization of a wide area west of the Rio Grande by peoples who produced or used ceramics produced east of the Rio Grande has been documented in previous petrographic studies. Ceramic temper of a monzonitic composition recovered from the Navajo-Hopi Land Exchange in southern Doña Ana County was attributed to an origin in the Organ Mountains (Garrett 1987). Similar materials from the Brazito North site (O'Laughlin 1985) were tempered using orthoclase-rich rocks that could have been derived from the Organ or Doña Ana Mountains (Hill 1988).

The use of temper derived from a source east of the Rio Grande in a sherd of San Francisco Red shows at least some sherds of this type were produced locally and were not trade items. Future analysis of early ceramic assemblages containing sherds of Alma Plain and San Francisco Red should include a more detailed petrographic study of these pottery types.

The other ceramics could have come from the same side of the river as Todsen Cave. However, evidence for particular sources of tempering material is limited by the lack of comparative analysis.

Petrographic analysis of the Todsen ceramic sample indicates many of the ceramics recovered contained tempering materials that most likely came from the Organ and Doña Ana Mountains, or both. The presence of such tempered ceramics throughout the Ceramic period occupation suggests episodic reuse of Todsen Cave by peoples who may have resided elsewhere. Smaller numbers of ceramics in the sample contained tempering materials that could have been obtained from sources closer to Todsen Cave, indicating local derivation as well.

Conclusions

Analysis of the ceramics from Todsen Cave raises questions regarding the way ceramics in the Jornada Mogollon region have been classified and what those classifications mean in terms of regional prehistory. First of all, the degree of surface finish and temper particle size may have little to do with the source or cultural affiliation of some of the different ceramic types. The majority of the sherds in the petrographic sample that would have been classified as El Paso Brown, Jornada Brown, Alma Plain, or San Francisco Red all were tempered using crushed rock derived from similar sources, the nearest of which was in the Doña Ana and Organ Mountains. Future analysis of these ceramic types should focus on further examination of the relationship between surface treatment, vessel form, and sources of ceramic temper in order to identify the source of the variations observed in this analysis.

The co-occurrence of Alma Plain, El Paso Brown, and San Francisco Red from the same source suggests the distinction between the Mimbres and Jornada Branches did not crystallize until sometime during the late Mesilla phase

(after A.D. 850), which brought a decline in the presence of Alma Plain-like ceramics and the appearance of Mimbres Whitewares. See O'Laughlin (1985) for an overview of the possible development of Mesilla phase ceramic types and vessel forms.

Based on the ceramic assemblages recovered from the different zones, use of Todsen Cave began in the Mesilla phase (sometime after A.D. 300), and continued through the Doña Ana phase around A.D. 1150 or perhaps somewhat later. However, with the exception of three sherds of El Paso Polychrome, which first was manufactured during the Doña Ana phase, there is no evidence of a later El Paso phase occupation unless the unidentified black-on-white sherd is from this period.

The use to which the prehistoric inhabitants of the Mesilla Valley put Todsen Cave is obscured by the evidence of trash removal from the main body of the rockshelter. This practice implies either lengthy occupation or frequent reuse of the site. The occupation may have been by the same or related social groups, as indicated by the similarity in temper sources through time. The large proportion of ceramic jar forms indicates emphasis on storage, transport, or food preparation. The preponderance of jar sherds at Todsen Cave is much different from the more even distribution of bowl and jar forms as well as the greater diversity of overall vessel types recovered from sites with architecture (Gerald 1988; Miller 1989). Since studies for the identification of different functional classes of ceramics in the Jornada Mogollon region are just beginning (Seaman and Mills 1985), we can expect further clarification of ceramic usage and its application to people's ways of life.

Part B: Chronometrics or Absolute Chronology

The preceding pages provided evidence about relative chronology, mainly of the Archaic period, in the Jornada region of southern New Mexico. We classified the lithics, ceramics, and other cultural materials found in stratigraphic contexts in three excavated sites (Todsen, Tornillo, and North Mesa) into various types showing trends through time. Before we discuss the chronometrics of these sites, let us briefly review what our relative chronology has accomplished and what further chronological data we need.

Summary of Relative Chronology

First and foremost, our typology not only has allowed us to describe the material culture of the ancient inhabitants of the region, but also to align it in neat groups of types–with clusters of significant attributes or modes–in their chronological order starting with various pre-Clovis chopper types and ending with pottery and point types used by Historic tribal groups. Yet, while these data give the relative life span of those types, or "time markers," they do not tell us exactly how long each type existed or in which area or region a particular type first was invented or how it diffused to other regions. For that information we need absolute dates.

Second, the relative chronology based on typology allowed us to use trends of types to align the components, zones, or levels of various sites in chronological order (as shown by the various tables of type classes in Part A). Many components, however, particularly at the North Mesa and Tornillo sites, contained so few artifacts we could not discern real trends. Radiocarbon dates on these components could help us fit them into the chronology when trends could not.

A correlation of types with stratified components revealed a chronology of type clusters in a series of components, and that gave us a preliminary definition of our culture phases–particularly in the Archaic of the Jornada region. Defining the Archaic in this region was a crucial step in our attack on the problem of the origin of agriculture in the American Southwest, which, of course, is an aspect of the more general problem of understanding how and why pristine agriculture occurred anywhere at any time.

Study of type clusters revealed a number of types were shared by four of the stratigraphically early components of our excavated sites–zone K1 in the bottom of Todsen Cave; feature 1 in upper zone C in the central section of North Mesa, upper zone C itself, and feature 8 in the southeast trench of the same site. Common to three of these four components were crude blades, snub-nosed end scrapers, denticulated scraper planes, large and small convex side scrapers, denticulated unifacial saws, Jay-like points, Bajada-like points, ovoid bifaces, pebble hammers, and half-moon side blades. Occurring only in zone K1 of Todsen were anvil-milling stones, pebble mullers, pebble cleavers, and large concave unifaces that also might be considered traits of this early complex. These tool types all may be considered diagnostic of the Gardner Springs components. Both the lower level of Fresnal Cave, with a possible Bajada-like point, and seven sites in Carmichael's Tularosa Basin survey that had similar points and five that had Jay points also may be Gardner Springs components.

Our typology thus provided a basis for defining the Gardner Springs phase as well as classifying various sites and components belonging to it. The points indicate obvious relationships to Jay and Bajada of the Oshara tradition in the Colorado Plateau (Irwin-Williams 1979), as well as Cochise in Arizona (Sayles 1983). Determining what that relationship is–ancestral, descendant, or contemporary–requires definite dating for each of these phases. Except for Sulphur Spring (Waters 1986), such definite dates presently are lacking in the Southwest.

The situation is only slightly better for the Keystone phase, tentatively defined by types from excavated components at Todsen–zone K (with the only adequate samples of types)–and North Mesa–zone lower B, and possibly features 13, 11, and 4. Pebble hammers, crude blades, snub-nosed end scrapers, pebble mullers, and denticulate saws occur at two of these components while convexly worked large and small unifaces occur at three and seem to carry on from the previous horizon. New and diagnostic to the Keystone phase are Almagre-Gypsum Cave points, large flake end scrapers, large flake scraper planes, and unifacial boulder milling stones, which occur in both zone K of Todsen Cave and zone lower B of North Mesa, while Lerma, Bat Cave, Amargosa-Pinto, Pelona, and Todsen points, as well as

discoidal mullers, slab metates, pebble choppers, and large ovoid bifaces occur only in zone K of Todsen. Although there is not a sufficient number of types to align all the components chronologically on the basis of type trends, various other sites or components in the Jornada region can be assigned to the Keystone phase on the basis of these diagnostic types. Level 7 of the Organ Mountain site of Rincon had a Todsen point; House 2 of Keystone had Pelona and Almagre-Gypsum points, and 23 Tularosa survey sites had various of the Keystone phase point types. Moreover, some of these Keystone types (such as Pelona, Bat Cave, and Gypsum) occur in other regions. Chronometric dates would improve our understanding of the definition of types and allow us to align components chronologically.

For the Fresnal phase we have 11 excavated components with many more artifacts. In fact, feature 6 and middle zone B of North Mesa and zones J1, J, and F of Todsen all have an adequate sample of artifacts of various types, even though zones D, C, and B of Tornillo and features 9 and 2 of North Mesa do not. Among the earlier types of lithics that seem to continue are small convex unifaces (at eight components), flake end scrapers (at six), large convexly worked unifaces (at five), denticulate unifaces and pebble choppers (at four), and crude blades, pebble mullers, denticulated scraper planes, ovoid bifaces, bifacial knives, flake scraper planes, and Todsen points (at three of these components). The real diagnostics of Fresnal, however, are a series of new point types–San Jose, Augustin, Chiricahua, La Cueva, Nogales, Fresnal, and Armijo–as well as such new ground stone types as bifacial slab, rockered, and boulder metates; rockered, wedge, and small rectangular manos; and sinew stones. Other diagnostic tools might include domed scraper planes, back-blunted half-moon unifaces, large pointed unifaces, T-shaped drills, and a host of perishable tools found only in Tornillo zones B, C, and D, which could not be placed in chronological alignment on the basis of uniface type trends.

A number of point types from other sites–Augustin and Chiricahua from the Cochise tradition and San Jose and Armijo from the Oshara tradition–are part of the Fresnal complex. Chronometric data on Fresnal components in the Jornada region, as well as on those from the contemporaneous Cochise and Oshara traditions, can help us see the chronological relationships at this time level, which is of great importance in understanding the initial spread of domesticates and agriculture in "Arid America."

The Hueco phase is an even more crucial period from the standpoint of origins of agriculture. Our excavated sites had a large number of components with large artifact samples–namely, zone πJ of Todsen and upper zone B and features 5 and 7 of North Mesa. Several Organ Mountain sites–zone A1 of Tornillo, and various levels of Roller Skate, Knee Pad, and Sonrisa–had corn races that were good time markers, while the various levels of La Cueva and Fresnal contained numerous projectile point types that allowed them to be aligned. Also, 89 of the Tularosa survey sites had Hueco projectile point types that allowed them to be assigned to the Hueco phase and be aligned in their chronological order. All in all, about 32 excavated and more than 89 surface components represented the phase.

The most temporally sensitive diagnostic types were the local Hueco, Hatch, and Padre Gordo projectile points, supplemented by the Cochise and San Pedro large and small types and the Oshara En Medio and (rarely) the Basketmaker II types. Almost as distinctive were the grinding stones–paint palettes, mortar and cobble pestles, two-handed manos, and boulder, trough, and Mexican and bifacial slab metates. Chipped stone tools included small point unifaces, gouges, small bifacial disks, plano-convex disk scrapers, flake and thumbnail scrapers, and flake choppers. Also diagnostic of the Hueco phase are various corn races, bone awls and probably various types of sandals, textiles, and basketry. Yet, despite the large samples of types showing trends, we also need chronometric dating to align the components.

Absolute Chronology

To supplement and improve our definition of trends and horizons, we need chronometric, or absolute, dating for all the Archaic periods identified at our excavated sites. We originally had hoped to derive dates by four techniques–archaeomagnetism, cross-dating, obsidian hydration, and radiocarbon (C14) determinations. Although Dr. Daniel Wolfman took two samples at the North Mesa site for archaeomagnetic dating, the one on feature 7 gave an inexact reading and the feature 6 sample was older than the present master archaeomagnetic graph for the Southwest.

Cross-dating these features, mainly with the Cochise and Oshara sequences, proved more successful, but the time lag in the diffusion of the cross-dated types, as well as other factors, prevented exact dating. Cross-dating did, howev-

er, provide data about the chronological relationships of the various Archaic phases in the American Southwest that are crucial to our understanding the spread of agriculture.

Radiocarbon Dates from AFAR Excavated Sites

More successful were the dates obtained from radiocarbon determinations and obsidian hydration calculations. (See Johnson and MacNeish 1972:14-15 for carbon collecting techniques.)

The earliest date on the Andover Foundation excavation material was on a piece of pronghorn antelope bone dug in 1986 from zone K, square N2W1, at Todsen Cave. Thanks to Austin Long's cooperation, it was dated by the University of Arizona Laboratory as 3669 ± 170 B.C. (A4561). R.E. Taylor from the University of California at Riverside helped us obtain a date of A.D. 830 ± (UCR2172) for a charcoal specimen from zone K, from the 1987 excavation of Todsen Cave in square N1W3, level 20. The date clearly was erroneous. I believe their comment helps explain the error: "Small sample size required dilution of sample for counting purposes resulting in increased statistical error."

Riverside also did the following dates, mainly in the Fresnal phase, which seem to be in a correct sequential order. The earliest one, 2560 ± 80 B.C. (UCR2420), came from charcoal from square N2E20, level 8, in feature 11 at North Mesa, the cobble-filled pit at the junction of zones B and C. Charcoal from feature 6, the slab-lined roasting pit in square S10E31, level 2, in the lowest part of zone B, yielded a date of 1600 ± 80 B.C. (UCR2422), while charcoal from the trench, feature 9 in square N3E21, level 6, in lower zone B, came out 1495 ± 90 B.C. (UCR2421). Charcoal from zone J1 of square N1W1 of Todsen Cave, analyzed by the University of Arizona, yielded a date of 1490 ± 80 B.C. (A4563). Bits of charcoal from five or six locations in feature 2, a large boulder-filled pit in the middle of zone B in squares S9E24, S10E24, and S10E23 at North Mesa, were determined by the University of California at Riverside to be 1260 ± 90 B.C. (UCR2423).

Of a very different nature was the next date in our series, obtained from Geochron Laboratories of Cambridge, Massachusetts, when the editor of the *American Anthropologist* demanded we directly date some of the earlier specimens before he would publish our article on early corn (Upham et al. 1987). We sacrificed eight cobs–our total sample from zone D of Tornillo Cave, consisting of four Chapalote cobs and a few cobs of Proto-Maiz de Ocho. The date established for the cobs and the zone D occupation as well was 1225 ± 240 B.C. (GX-12720), which cannot be "older or younger than the derived date" (Wills 1988). This radiocarbon determination allows us to align Tornillo chronologically with North Mesa and Todsen components, which our relative typological chronology could not do. It places Tornillo zone D as chronologically older than the middle of zone B above feature 6, in square S10E31 at North Mesa, charcoal from which Riverside dated at 1140 ± 90 B.C. (UCR2424).

The Tornillo date also seemed older than the dates we received for zone J of Todsen Cave, but we encountered problems dating that downslope zone. When we sent two samples of charcoal from the same hearth in zone J of square N1W2 to both Arizona and Riverside, we received dates of 860 ± 170 B.C. (A4562) and 960 ± 200 B.C. (UCR2121), neither of which we found satisfactory. More importantly, zone J represented the end of the Fresnal phase and the beginning of Hueco, when corn, beans, and squash become important. We therefore sent in two more charcoal specimens from zone J, taken from squares N1W4 and N2W1, and obtained the dates of 910 ± 90 B.C. (UCR2331) and 930 ± 100 B.C. (UCR2332). The transition from Fresnal to Hueco thus seems to fall between 830 and 960 B.C.

For our final Archaic phase, Hueco, we received fewer radiocarbon determinations, but more obsidian hydration dates. The earliest Hueco date seems to be on burial 4 from Todsen Cave, which was intrusive from zone E2 into zone J in level 11 of square N1W4. Arizona dated a sample of charcoal from a wood burial cover at 850 ± 80 B.C. (A4366). A piece of the parietal of the skull of a juvenile burial (#4) yielded a date of 200 ± 100 B.C. (UCR2169) from Riverside. Since burial 6 in square N1W3 from zone E1 lay over part of burial 4, we sent charcoal from it to Riverside and received a date of 600 ± 100 B.C. (UCR2120). I therefore suspect the Arizona date on burial 4 is the more accurate.

The next two radiocarbon dates in our Hueco series came from material in upper zone B of North Mesa and went to Riverside for dating. Charcoal from feature 5, a pit of fire-cracked rock in S11E30, was dated at 460 ± 100 B.C. (UCR2425), while charcoal in feature 7, a hearth associated with a series of grinding stones in N0E27, was dated at A.D. 40 ± 100 (UCR2426).

Charcoal from the 1987 excavations of zone πJ in square N2W2 of Todsen Cave was dated by Arizona. One sam-

ple came from feature 2, a hearth, and gave a date of 810 ± 70 B.C. (A4505). The other sample of charcoal came from outside, or perhaps above, the hearth in the downsloping zone πJ and gave a date of A.D. 187 ± 80 (A4515). Although these dates seem inconsistent, I believe they are valid and roughly delimit the span during which refuse was deposited on the north-sloping talus of Todsen Cave. Our span of dates, from 850 B.C. to at least A.D. 150, for the Hueco phase is roughly consistent with dates for this phase from other nearby sites.

Radiocarbon Determinations from Other Sites

Although not as numerous as the dates from our excavations, radiocarbon determinations from other stratified sites in the Jornada region cover a longer time span. The earliest ones–6119 ± 126 B.C. (ISGS812) and 5951 ± 125 B.C. (ISGS845)–came from two adjacent hearths in zone H in Fresnal Cave and supposedly were associated with Archaic materials (Carmichael 1982). However, even though a Bajada point was found deep in the shelter, it is not certain these dates pertain to the Gardner Springs phase. Another early date, 4400 ± 118 B.C. (I 4281), came from charcoal in an arroyo east of the San Andres Mountains (Gile et al. 1981), which was near a large boulder anvil-milling stone, a tool common in the Gardner Springs phase. That type of tool, however, has a long life span and whether the date is a valid Gardner Springs one is open to question. The dating of the Gardner Springs phase therefore remains tentative.

Supplementing our Keystone dates of 3669 and 2560 B.C. was a radiocarbon determination of 2790 ± 310 B.C. (RL1159) from House 2 of site 33 of the Keystone site north of El Paso. Since Pelona and Almagre-Gypsum Cave points, both good Keystone diagnostics, occurred within that house, there can be little doubt of the validity of this date for the phase (O'Laughlin 1980). Nevertheless, the limited number of Keystone dates indicates a need for more extensive testing.

In addition to sites excavated by AFAR, the related Fresnal and Keystone sites provide more dates for the Fresnal phase. From zone 4 of site 33 at Keystone, which contained Fresnal and Chiricahua points (both good Fresnal diagnostics), we have the following dates:

House 5: 2350 ± 210 B.C. (RL1164)
House 3: 2090 ± 90 B.C. (RL1158)
Hearth 5: 1910 ± 220 B.C. (RL1163)
House 4: 1590 ± 210 B.C. (RL1157)

The Fresnal cave site yielded the following radiocarbon determinations:

Zone G (carbon): 2111 ± 153 B.C. (GX-488)
Zone F (plant remains): 1510 ± 146 B.C. (ISGS888)
Zone C1 (carbon): 1360 ± 146 B.C. (ISGS933)

In addition, all these zones had large samples of points diagnostic of the Fresnal phase–Todsen, San Jose, Augustin, Chiricahua, La Cueva, Fresnal, and even Maljamar. Zone C at Fresnal, which had both Hueco and Fresnal points, may reflect the transition from Fresnal to Hueco; it yielded dates of 1010 ± 70 B.C. (ISGS969) and 925 ± 116 B.C. (ISGS897).

The Keystone and Fresnal sites also produced some dates for the Hueco phase.

Fresnal zone B, Level 1:	125 ± 116 B.C. (ISGS807)
Keystone zone 2:	130 ± 230 B.C. (RL1160)
	A.D. 250 ± 140 (RL1162)
	A.D. 380 ± 150 (RL1161)

Zone 2 of Keystone also had San Pedro and Hueco points (O'Laughlin 1980:37).

Although the numerous dates on Ceramic period sites are outside our realm of discussion of the Archaic, four are worth mentioning since they come from charcoal from Peña Blanca, a site near Tornillo in the Organ Mountains. Lev-

el 3 of Peña Blanca had Doña Ana type sherds, while there were El Paso phase sherds in Level 2. These components also were dated to roughly the same time period by the method of obsidian hydration.

Level 3: A.D. 1150 ± 70 (Beta 6860)
A.D. 1160 ± 60 (Beta 6861)
Level 2: A.D. 1330 ± 50 (Beta 6858)
A.D. 1420 ± 60 (Beta 6859)

Table IV-17. Some Chronometric Dates of Various Components in the Jornada Region

NORTH MESA	FRESNAL	TODSEN	PEÑA BLANCA	RINCON	KEYSTONE	LA CUEVA	TORNILLO	KNEE PAD	SONRISA	ROLLER SKATE	THORN	RADIOCARBON DETERMINATIONS	OBSIDIAN HYDRATION ESTIMATES	PHASES/DATES
		C											A.D. 1625, 1675	A.D. 1350
			1											
			2			0						A.D. 1330, 1420	A.D. 1084	
		D												EL PASO
			1											
				2									A.D. 1135	
				3									A.D. 1118	
											1			A.D. 1150
										1				
				4									A.D. 994	DOÑA ANA
			3									A.D. 1150, 1160	A.D. 783	
		D1											A.D. 729	A.D. 900
			4										A.D. 994	
		F+									2			
										2				
									1					
										3			A.D. 88	MESILLA
			5											
AB							A							
F2						1.7m								
		D2												
									2				A.D. 260-300	A.D. 250

Table IV-17. continued

NORTH MESA	FRESNAL	TODSEN	PEÑA BLANCA	RINCON	KEYSTONE	LA CUEVA	TORNILLO	KNEE PAD	SONRISA	ROLLER SKATE	THORN	RADIOCARBON DETERMINATIONS	OBSIDIAN HYDRATION ESTIMATES	PHASES/DATES
				5									A.D. 244	
											3			A.D. 250
				6										
						below surface					4			
										4				
									3				A.D. 182	
		E											A.D. 187	
F7												A.D. 40		
Upper B						1.8-2m								
														A.D. B.C.
						2.1-2.3 m								
											5			
F3, 10	B											125 B.C.		
										6				
					2							130, 160, 182 B.C.	182 B.C.	
						2.4-2.5 m				7-7				HUECO
F5												460 B.C.		
						2.6-2.7 m								
						2.8-3.1 m								
								1						
							A1						548 B.C.	
									4					
									5					
		E1										600 B.C.	548 B.C.	
								2						
								3						
									6					
								4						
								5						
		πJ										810 B.C.	817, 490 B.C.	
		E2										850, 200 B.C.		900 B.C.

Table IV-17. continued

NORTH MESA	FRESNAL	TODSEN	PEÑA BLANCA	RINCON	KEYSTONE	LA CUEVA	TORNILLO	KNEE PAD	SONRISA	ROLLER SKATE	THORN	RADIOCARBON DETERMINATIONS	OBSIDIAN HYDRATION ESTIMATES	PHASES/DATES
		F										830 B.C.		900 B.C.
		J										860, 910, 960 B.C.		
							B							
							C							
	C											925, 1010 B.C.		
Middle B												1140 B.C.		
							D					1225 B.C.		
						3.2-3.3 m								
F2												1260 B.C.		
	C1											1360 B.C.		
		J1										1490 B.C.	1100 B.C.	FRESNAL
F9												1495 B.C.		
	F1											1510 B.C.		
					Z4A							1590, 1910 B.C.		
F6												1600 B.C.		
					Z4B							2090, 2350 B.C.		
						3.4-3.7 m								
	G											2111 B.C.		
						3.8-4.5 m								
						4.6+ m								2600 B.C.
F4														
									6				2525 B.C.	
F11												2560 B.C.		
				House 2								2790 B.C.		
				7 Todsen Points						7			3057, 3095 B.C.	KEYSTONE
				Bat Cave Point									3119 B.C.	
Lower B														

Table IV-17. continued

NORTH MESA	FRESNAL	TODSEN	PEÑA BLANCA	RINCON	KEYSTONE	LA CUEVA	TORNILLO	KNEE PAD	SONRISA	ROLLER SKATE	THORN	RADIOCARBON DETERMINATIONS	OBSIDIAN HYDRATION ESTIMATES	PHASES/DATES
F13 F5 Upper C	F	K										3669 B.C.	3434 B.C.	KEYSTONE 4500 B.C.
F1-C1	H		7 8 K1									4400 B.C. 5951, 6119 B.C.		GARDNER SPRINGS 6000 B.C.
		M-N												Folsom?
Lower C D														CLOVIS?

Obsidian Hydration Dating from AFAR Excavated Sites

From 1983 through 1987 we were most fortunate in having the services of Chris Stevenson, who was undertaking obsidian hydration studies for the Cultural Resources Management program of New Mexico State University. He studied some of our materials made of obsidian along with materials from Upham's excavation in the Organ Mountains, while we provided our radiocarbon determinations to help him chronometrically calibrate his obsidian-rind measurements. Of the ten specimens he analyzed for us, five were associated with carbon for which we had radiocarbon determinations.

The earliest date, on an obsidian chip from zone K of Todsen Cave, was 3434 ± 362 B.C. (NMSU86-187), and that was close to the C14 date of 3669 B.C. The second earliest obsidian chip, from zone J1 in Todsen Cave, was dated by obsidian hydration at 1100 ± 274 B.C. (NMSU86-226); that zone had been C14 dated at 1490 B.C.

An obsidian chip from zone B of Tornillo Cave gave a date of 910 ± 266 B.C. (NMSU86-213), but no associated materials were radiocarbon dated. However, materials from zone πJ of Todsen, radiocarbon dated at 810 B.C., were associated with two obsidian flakes that were obsidian hydration dated at 817 ± 262 B.C. (NMSU86-237) and 490 ± 246 B.C. (NMSU86-229). Also, an obsidian chip inside the pit of Burial 6, which was carbon dated at 600 B.C., gave a hydration date of 548 ± 249 B.C. (NMSU86-225). The same hydration date, 548 ± 249 B.C. (NMSU86-212), also came from a chip in zone A1 of Tornillo Cave.

From one of the latest zones of the Hueco phase in Todsen Cave, radiocarbon dated at A.D. 150, we sent in an obsidian chip that turned out to be A.D. 182 ± 210 (NMSU86-228). The final obsidian dates from Todsen all were on obsidian flakes in ceramic-associated zones. A chip from zone D1 yielded A.D. 729 ± 177, and chips from zone C, associated with historic goods, yielded dates of A.D. 1625 ± 97 (NMSU86-231) and A.D. 1675 ± 97 (NMSU86-232).

Agreement between our radiocarbon determinations and obsidian hydration calculations thus was quite good. The latter technique even gave us an additional five dates and added many more dates for the Organ Mountain caves Upham excavated.

This obsidian hydration technique was used on a Bat Cave point from an Organ Mountain site, BK42, that Dave Batchco's group surface collected. Its date, calculated by Penn State, was 3119 ± 187 B.C. (448-41-12). The next two dates for the Keystone phase came from Todsen obsidian points. An obsidian point from level 7 of Roller Skate yielded the date 3095 ± 350 B.C. (NMSU85-88), while one from level 7 of Rincon gave a reading of 3057 ± 349 B.C. (NMSU85-97).

For the Fresnal phase we had obsidian artifacts from level 6 of Sonrisa shelter dated at 2525 ± 300 B.C. (NMSU86-245), and a date of 1970 ± 310 B.C. (NMSU87-78) on an obsidian point from mixed levels of Peña Blanca.

Hueco phase levels from the Organ Mountain shelters yielded six dates, most from Hueco or San Pedro large points:

Sonrisa Level 3:	182 ± 231 B.C. (NMSU86-251)
Roller Skate Level 6:	138 ± 228 B.C. (NMSU85-87)
Sonrisa Level 3:	A.D. 182 ± 210 (NMSU86-250)
Rincon Level 5:	A.D. 244 ± 207 (NMSU95-93)
Sonrisa Level 2:	A.D. 260 ± 206 (NMSU86-247)
	A.D. 308 ± 204 (NMSU82-248)

Although out of our realm of discussion, we obtained dates from a number of Ceramic levels of the Organ Mountain shelters. Associated with Mesilla pottery was a chip that dated A.D. 88 ± 217 (NMSU85-86), which seems too early. Associated with Doña Ana pottery was a chip from level 3 of Peña Blanca, dated at A.D. 983 ± 173 (NMSU85-85); the same level was radiocarbon dated at A.D. 1150 and 1160. Also early was a chip that dated A.D. 994 ± 156 (NMSU85-99), associated with Doña Ana pottery in level 4.

Obsidian from levels associated with El Paso phase sherds also seemed to have slightly early dates. Level 2 of Peña Blanca, which C14 dated at A.D. 1330 and 1420, had an obsidian calculation of A.D. 1084 ± 155 (NMSU85-80), while one from Rincon level 3 was A.D. 1118 ± 143 (NMSU85-91), and Rincon level 2 had A.D. 1135 ± 147 (NMSU85-90). Although these obsidian hydration calculations are far from perfect, they do allow us to date the Jornada Archaic fairly well (see Table IV-17).

Relationships of Southwest Archaic Sequences

Now the question becomes, how well does the Jornada Archaic cross-date with related Archaic sequences in the other parts of the Southwest?

Dating of Paleo-Indian Remains. The next-to-earliest part of our sequence–zone D of North Mesa with its Clovis points–relates to various Clovis sites in southern Arizona, which have been dated from 9180 ± 500 B.C. (A8030) at Escalentes (Hemmings and Haynes 1969) to 10,060 ± 80 B.C. (A40) at Lerner (Haury et al. 1959). We may have an occupation not only at zone D of North Mesa at this time, but also possibly one before it, in zone E.

The next complex in our Jornada sequence is possibly Folsom, found in zones M-N of Todsen. The type site is Folsom, New Mexico, in the Colorado Plateau. Folsom remains also have been found just to the east of our region at Lubbock Lake, Texas; and Blackwater Draw, New Mexico; overlying Clovis remains and bearing dates of about 8500 ± 500 B.C. (Turner and Hester 1985). Folsom points are relatively rare in the Big Bend area to the east as well as in the Mogollon Rim and Gila Drainage to the west, but there are hints this type of point may exist in the same time range. Farther west, in Arizona and the deserts of California, Folsom may not exist; it probably is replaced in this time period–9000-8000 B.C.–by San Dieguito (Haury 1950) or related cultural entities (Waters 1986).

The next time level, that of our poorly defined complex with Angostura points, provides graphic evidence of the east-west dichotomy. Angostura points from the surface of North Mesa and the Tularosa survey area are more preva-

lent in west Texas and the Plains to the north and date from 7500 to 6000 B.C. (Turner and Hester 1985). Occasionally these points occur with Golondrina points of the Big Bend area of Texas at roughly the same time (Shafer 1985). Angostura points resemble and occasionally occur with the Cody remains of the Irwins' site in the Colorado Plateau in this time period (Irwin-Williams 1979).

Exactly what occurs in the Mogollon Rim at this time is unknown, but in the Gila we have the Sulphur Spring phase with the whole new "Desert Culture" complex (Jennings 1964) of grinding stones, scraper planes, and other (rare) point types. In an acute reanalysis and redating by 17 radiocarbon determinations, Mike Waters (1986) dates this phase between 8040 and 5080 B.C., with the majority of the dates falling in the same 7000 to 6000 B.C. range as our Angostura complex. For the record, dates on Sulphur Spring come from various sites in southeast Arizona, as follows:

Lerner:	8040 ± 80 B.C. (SMU204)
	7910 ± 80 B.C. (SMU197)
FF:10:1:	7020 ± 220 B.C. (A3378)
	6890 ± 210 B.C. (A3379)
	6810 ± 310 B.C. (A3377)
FF:6:8:	7390 ± 180 B.C. (A3238)
	6190 ± 160 B.C. (A3314)
	6700 ± 180 B.C. (A3232)
	6550 ± 180 B.C. (A3231)
	6440 ± 190 B.C. (A3233)
Lerner 2:	6290 ± 960 B.C. (A1846)
	6250 ± 450 B.C. (C6511)
	5606 ± 370 B.C. (C216)
	5080 ± 260 B.C. (A1840)

Further to the west, in California, the poorly defined San Dieguito 2 complex (Haury 1950) has artifact types that may resemble Sulphur Spring and be of the same time period, but the complex has few good dates. Like Sulphur Spring, it may last until 5500 B.C. and overlap with Gardner Springs, with which it has many artifact resemblances–pebble and cleaver choppers, scraping planes, pebble mullers, hammerstones, and anvil mortars.

The much earlier dates than Gardner Springs on Sulphur Spring may mean, as Irwin (1973) has suggested, that this earliest Cochise manifestation may be ancestral to our Gardner Springs and Jay and Bajada complexes of Oshara (Irwin-Williams 1979).

Relationships to Gardner Springs. On the Gardner Springs time level (6000-4000 B.C.), the best resemblance of artifacts from the Chihuahua and Oshara traditions is not to Sulphur Spring but to Mohave in the southern California desert. In my opinion, this similarity exists because no cultural manifestation (including the mythical Cazadors, see Beckett and MacNeish 1987) of this time period has been found or defined for the Gila Drainage or Mogollon Rim regions (MacNeish 1989). Mohave-Gardner Springs, Jay, and Bajada not only have mullers and milling stones, choppers and scraper planes in common, but also Jay and Bajada points. Although few reliable dates exist on Mohave, the Colorado Plateau sites of Armijo Tanks and Armijo East bear the following dates:

Jay phase:	5680 ± 140 B.C. (A809A)
	4930 ± 400 B.C. (M346)
Bajada phase:	4820 ± 240 B.C. (GX-0376)
	4450 ± 530 B.C. (I 2903)
	4110 ± 180 B.C. (GX-0375)

On the basis of the above dates, I suggest Bajada dates from roughly 4450 to 5810 B.C., while Jay runs from the later date well into the seventh millennium B.C. This chronology also would be in agreement with the Black Mesa site (0:11:3063), which has Bajada points in association with radiocarbon dates of 6130 ± 160 B.C. and 5860 ± 50 B.C. (Parry and Christensen 1987).

Table IV-18. A Comparison of Archaic Sequences in the American Southwest

CALIFORNIA DESERT	PAPAGUERIA	GILA	MOGOLLON RIM	CHIHUAHUA HUECO	OSHARA ARROYO CUERVO	KAYENTA CHUSKA	COLORADO SAN JUAN	DATES
					En Medio	Lolomai	Butler Wash	500 A.D. 0
	San Pedro	San Pedro	San Pedro	Hueco		White Dog	Grand Gulch	500 B.C.
Silver Lake								1000 B.C.
				Fresnal	Armijo	Black Mesa Late Archaic		2000 B.C.
Pinto	Chiricahua Amargosa	Chiricahua	Chiricahua AKE?		San Jose	Black Mesa San Jose-like	Burial 2, San Dune Cave San Jose	3000 B.C.
			Bat Cave?	Keystone		Black Mesa Early Archaic		4000 B.C.
Amargosa	Amargosa 1				Bajada	Black Mesa Bajada-like	Deshe	5000 B.C.
San Dieguito 3			?	Gardner Springs	Jay			6000 B.C.
San Dieguito 2		Sulpher Spring	?	Angostura	Cody			7000 B.C.
			Folsom	Folsom	Folsom			8000 B.C.
San Dieguito 1	Ventana	Clovis		Clovis	Clovis			10,000 B.C.
				North Mesa				

To the east, in the Big Bend area, are the Baker complex and in west Texas the San Geronimo and/or Firstview complexes (Turner and Hester 1985). These complexes have no Jay or Bajada projectile point types or grinding stones or scraper plane types in common with Gardner Springs or Jay-Bajada. At this time, therefore, the culture border between the Southwest and Texas can be established as roughly from Portales in New Mexico to Van Horn in Texas and westward to the rest of the Southwest and California (and perhaps including northern Mexico and southern Utah-Colorado and Nevada) to represent a culture area that housed the Desert Culture tradition (Jennings 1964).

Relationships to Keystone. On the next time level, 4300 to 2600 B.C., the Keystone phase occurs in the Jornada region. Its relationship to outside areas, other than the Colorado Plateau, is difficult to establish. To the east, in Baker in the Big Bend (Shafer 1986) and Jorrella and Oakalla in west Texas (Turner and Hester 1985), few artifact type resemblances exist except for an occasional Pedernales point and possibly Almagre-Gypsum points.

To the west, in the Mogollon Rim and Gila area, no manifestations of the early part of this time period seem to appear, although Chiricahua often is pushed back into this time frame. Cited for such an early dating of Chiricahua are the dates of 3635 ± 290 B.C. (C571) and 3981 ± 310 B.C. (C573) at Bat Cave (Sayles 1983), but there is no evidence these dates were associated with Chiricahua remains. In fact, they came from the brown sands or yellow sediments (probably associated with Bat Cave points) that, according to our Keystone data, may well be of a complex that precedes Chiricahua and is related most closely to Fresnal (Wills 1988). Also, none of the actual radiocarbon dates on Chiricahua are earlier than 3400 B.C., with most, like Fresnal and San Jose, in the 2600-1500 B.C. range. Perhaps Keystone's closest ties to the Oshara region are to the Deshe complex (5200-3200 B.C.) because both have Almagre-Gypsum, Todsen, and Pinto-like points in common as well as discoidal mullers, milling stones, and scraper planes. This Deshe complex could well fill the gap from Bajada to San Jose. I believe the date of 3810 ± 120 B.C. (GX-0374) for late level 9 of Armijo Tanks probably is from a Deshe-like complex rather than Bajada, that the hearth in Ojoto Dunes that dates 3210 ± 120 B.C. (I 2213) is for the earliest San Jose, and that the Lobo zone of LA9224 at the Cueva Neca site dating at 2730 ± 140 B.C. (M988) is from a similar period. The above dates show these sites are of roughly the same time period. In common to these manifestations would be Amargosa-Pinto, Pelona, and Gypsum-Almagre points, as well as pebble scraping planes, boulder milling stones and metates, mullers and crude manos.

Far to the west, this set of types bears general resemblances to the Ventana complex in the Red Sands of Ventana Cave (Haury 1950) and the Amargosa I and Silver Lake complexes in California (Warren 1967), but neither is dated well enough to determine if it is of the exact same time period.

Relationships to Fresnal. The relatively poor relationships on the Keystone time level (4300-2600 B.C.) contrast with the next time level, 2600-900 B.C., the period of the Fresnal culture in the Jornada region. San Jose of the Colorado Plateau, Pinto of California, Chiricahua of the Mogollon Rim and Gila, and Fresnal of the Jornada have in common San Jose, Amargosa (Pinto), and Pelona points as well as scraper planes, boulder metates, and pebble manos. San Jose, Fresnal, and Chiricahua also have Augustin and Todsen points in common, while Fresnal and Chiricahua have La Cueva and Chiricahua points and gouges. San Jose-Armijo and Fresnal have Armijo and Fresnal points in common. These sites all contrast with Pandale in the Big Bend (Shafer 1986) and the Middle Archaic in west Texas (Turner and Hester 1985) that at most have in common with Fresnal gouges and Pelona and Gypsum-Almagre points and thus bear few resemblances to other contemporary phases farther west.

On the Colorado Plateau, San Jose has the following dates:

3210 ± 120 B.C. (I 2213)
2730 ± 140 B.C. (M988)
2510 ± 490 B.C.
1800 ± 160 B.C. (GX-0915)

Armijo has dates as follows:

1700 ± 220 B.C. (I 2629)
1660 ± 130 B.C. (GX-0919)
1560 ± 160 B.C. (I 2667)
1530 ± 95 B.C. (GX-0918)
1440 ± 120 B.C. (I 2211)
1140 ± 140 B.C. (I 2668)
1085 ± 95 B.C. (GX-0916)
800 ± 210 B.C. (I 2210)

As the above dates show, San Jose and Armijo should overlap in part with Fresnal.

Also related to Fresnal would be the Armijo phase Chaco site (LA17337), which is dated at 1730 ± 85 B.C. (UGA3622) and 1610 ± 95 B.C. (UGA3623); LA18103 dated at 2035 ± 155 B.C. (UGA3627) and 1700 ± 70 B.C. (UGA3628).

This chronology also holds true for Chiricahua, which seems to date between 3400 and 1400 B.C. (Minnis 1985). Dates from Murray Springs are roughly contemporaneous with those of Cienagas Creek.

Murray Springs:	3330 ± 330 B.C. (A187)
	2170 ± 490 B.C. (A186)
Cienagas Creek:	3400 ± 230 B.C. (A3308)
	3170 ± 130 B.C. (A3310)
	2890 ± 800 B.C. (A3311)
	2620 ± 70 B.C. (A3312)
	250 ± 120 B.C. (A3384)
	2450 ± 190 B.C. (A3313)
	2430 ± 150 B.C. (A29)
	2360 ± 160 B.C. (A195)
	2050 ± 150 B.C. (A29)
	2030 ± 160 B.C. (A29, A22)

Double Adobe shows similar dates–3410 ± 300 B.C. (A192, A193), 1810 ± 200 B.C. (A194), and 1550 ± 110 B.C. (A3183). Wet Leggett, with a date of 2558 ± 680 B.C. (C556), and Arizona site 11, with a date of 2056 ± 270 B.C. (C515), fall roughly in the middle. Most of these sites were in the Gila Drainage. Also, the dates of 1410 and 1490 B.C. occur with Chiricahua remains at the AKE site on the Mogollon Rim (Beckett 1980). The Chiricahua dates thus suggest it is contemporaneous with part of Fresnal, that is, in the period from 2600 to 1400 B.C.

Although the California complexes, Amargosa II and Pinto Basin, are not dated well, they should fall in the general range from 3400 to 800 B.C. The Desert tradition therefore seems to extend into southern California and northern Mexico, where its limits are less well known than in the east and north of the region. Only with our final period, Hueco, does the border of the Southwest tradition become what it is in Ceramic times with its distinctive pattern of village agriculture.

Relationships to Hueco. The final period, from roughly 1000 B.C. to the early centuries of the Christian era, has three distinctive (although slightly differing) Archaic phases in the Southwest: (1) Hueco in the Jornada region of the Chihuahua Desert of south-central New Mexico and Chihuahua, (2) Late Armijo and En Medio (formerly Basketmaker II) in the Anasazi region, and (3) San Pedro in the Mogollon Rim and the Gila Drainage. Common to all three traditions are San Pedro large and small and En Medio points, trough metates, T-drills, two-handed manos, small disk bifaces, small plano-convex scraper planes, Ulna awls, and many perishable basket, sandal, and net types, as well as use of corn, beans, and squash. Occasional Hatch points occur in En Medio sites, and Armijo and Basketmaker II points are present in Hueco sites, while San Pedro sites in the eastern area occasionally have Hueco points and many sandal types in common with Hueco (Cosgrove and Cosgrove 1947). Basketmaker points occasionally occur in western San Pedro sites as do noninterlocking and twined baskets.

The En Medio phase has many sites that have been dated both by C14 and dendrochronology, showing it to have occurred from roughly 800 B.C. to A.D. 500 (Irwin 1966). Also related are components from (Minnis 1985):

Jemez Cave:	740 ± 125 B.C. (M466)
Cowboy Cave:	165 ± 70 B.C. (SI2422)
Clyde Canyon:	A.D. 211 ± 100 (KL175)

the following Chaco sites (Simmons 1986):

Sheep Campshelter:	340 ± 210 B.C. (A3396)
	270 ± 290 B.C. (A3159)
	A.D. 220 ± (A3345)

Abshslepah Shelter:	255 ± 65 B.C. (UGA4606)
	A.D. 550 ± 80 (UGA4605)

and the Black Mesa sites (Parry and Christensen 1987). The above En Medio dates overlap with Hueco, which may have started and ended slightly later.

San Pedro seems to have started earlier, perhaps 1400 or 1500 B.C., and ended later, with the appearance of pottery– Hohokam wares to the west and Mogollon to the east–at about the time of Christ or a century later rather than A.D. 250, the time when Mesilla may begin in the Jornada region. From the three major sites in the Gila Drainage (Minnis 1985) we have the following dates, in chronological order:

Cienagas Creek:	1430 ± 200 B.C. (H51)
	950 ± 150 B.C. (A26B)
	1300 ± 200 B.C. (A50)
	1240 ± 150 B.C. (A27B)
	1240 ± 160 B.C (A51B)
	1230 ± 300 B.C. (A89A)
Matty Canyon:	1215 ± 300 B.C. (A86C)
	1130 ± 300 B.C. (A86C)
Cienagas Creek:	1120 ± 150 B.C. (A27)
Matty Canyon:	1030 ± 300 B.C. (A88H)
Cienagas Creek:	950 ± 150 B.C. (A26B)
	910 ± 440 B.C. (A194)
	850 ± 110 B.C. (SH5356)
Double Adobe:	910 ± 440 B.C. (A194)
Matty Canyon:	790 ± 250 B.C. (A88D)
Cienagas Creek:	750 ± 160 (A25bis)
	670 ± 200 B.C. (A89A)
	660 ± 200 B.C. (A49)
	660 ± 250 B.C. (A87)
Matty Canyon:	600 ± 300 B.C. (A85)
Cienagas Creek:	570 ± 900 B.C. (A89C)
	540 ± 176 B.C. (A26bis)
Matty Canyon:	520 ± 200 B.C. (Sh5665)
Cienagas Creek:	490 ± 160 B.C. (A25B)
	340 ± 190 B.C. (A3181)
Matty Canyon:	270 ± 150 B.C. (A92)
	240 ± 180 B.C. (A196)
	200 ± 140 B.C. (Sh535a)
Cienagas Creek:	190 ± 60 B.C. (A227A)
	150 ± 150 B.C. (A20, A23)
	130 ± 200 B.C. (A53)
Matty Canyon:	60 ± 150 B.C. (A88bis)
	A.D. 1 ± 150 (A88bis)
	A.D. 100 ± 150 (Sh5358)
Cienagas Creek:	A.D. 50 ± 160 A.D.
	A.D. 160 ± 250 A.D. (A2278)
Hay Hollow, house 17:	48 ± 60 B.C. (GX-580, 248, 799)
Hay Hollow, house 23:	3 ± 61 B.C. (GX-192, 927)
Hay Hollow, house 22:	0 ± 55 B.C.

We therefore have at least 40 radiocarbon determinations ranging from 1430 B.C. to A.D. 160 for the San Pedro phase in the Gila.

From the San Pedro sites of the Mogollon Rim region we have more than 15 dates–ranging from 30 ± 120 B.C. (A3661) to 1170 ± 76 B.C. (A4188) on remains from Bat Cave. Other San Pedro dates are as follows:

190 ± 135 B.C. (A4181)
310 ± 135 B.C. (A365a)
390 ± 420 B.C. (A2791)
510 ± 220 B.C. (A4183)
560 ± 120 B.C. (A3658)
610 ± 80 B.C. (A3789)
680 ± 90 B.C. (A4182)
740 ± 90 B.C. (A4185)
830 ± 90 B.C. (A4166)
1030 ± 120 B.C. (A4186)
1060 ± 150 B.C. (A4167)
1110 ± 110 B.C. (A4189)

Mainly from the Preceramic levels of Tularosa Cave are the following dates:

Block Cave:	830 ± 200 B.C. (M717)
	650 ± 100 B.C. (M718)
Cordoba Cave:	810 ± 60 B.C. (Beta 9761)
Tularosa Cave:	523 ± 200 B.C. (C584)
	475 ± 200 B.C. (C612)
	320 ± 160 B.C. (C585)
	130 ± 200 B.C. (M715)
	A.D. 20 ± 140 (A4180)
	A.D. 10 ± 90 (A4181)
	A.D. 50 ± 70 (A4178)

In addition we have the more recent dates of 520 ± 250 B.C. (A 4179), analyzed on domesticates, and 110 ± 200 B.C. (M716, Martin et al. 1952). These Mogollon dates suggest that perhaps San Pedro starts a little later in the Mogollon Rim than in the Gila Drainage and that there might be a gap between it and the poorly defined Chiricahua remains of that highland region (Wills 1988). At present, however, the data are too unreliable to test this hypothesis definitely, although the main cross-dates of San Pedro and En Medio to Hueco strongly suggest Hueco had strong relationships with them between 1430 B.C. and A.D. 100.

Connections between Texas and the Hueco region–and for that matter the Southwest in general–are vague and unsatisfactory. In the Big Bend region this is the period of the Devils Interval complex (1000 B.C. to A.D. 500), and few connections with the Jornada region exist, except for the stray finds of Shumla or Shumla-like points in Hueco sites (Shafer 1987). In west Texas this period would have the Late Archaic Uvalde, Twin Sister, and Driftwood complexes, which show even fewer connections with the Southwest, except for the strange Maljamar points found in very few Hueco sites (Leslie 1978). In fact, by Hueco times the break has been made between the Southwest and Texas–the Southwestern traditions go on to village agriculture while the Texans remain collectors and hunters.

A similar break also seems to occur west of the Colorado, where the Amargosa III complex and Rose Spring show the Californians continuing their forager-pithouse way of life (Lanning 1989). Also, the Irwins' excavation of Magic Mountain to the north (Irwin and Irwin 1966) and the Lo Dais Ka site in Colorado near Denver show diminished connections to the Southwest (Irwin-Williams and Irwin 1959). Although points similar to Basketmaker and/or San Pedro large and En Medio do appear west of the Colorado, the grinding stones and scrapers are different, as is the subsistence complex without domesticates.

By the end of Hueco times, therefore, the basic Southwest pattern and cultural subareas had been established. As has been noted, Jornada ceramic remains belonging to at least four complexes–Mesilla, Doña Ana, El Paso, and Apache–did occur in the upper levels of Todsen Cave, but, except for sherds, stone tools were so few that determining relationships by this medium on that time period is difficult. Further studies of remains of these three or four time periods are outside our problem area and purpose of our investigations and we have left them to other investigators.

The following paragraphs briefly review the chronometric dates for the four phases of the Archaic in the Jornada region.

As we have stated earlier, our Paleo-Indian components–zones E and D of North Mesa, as well as our possible Folsom and Angostura manifestations–can be cross-dated only to the period roughly from 6000 to more than 10,000 B.C. All these components were represented poorly and were basically out of our frame of reference. What is pertinent to our problem are the dates on our Archaic phases, for which we have more materials, direct dates, and cross-dates.

Unfortunately, our poorly represented earliest phase, Gardner Springs, is not dated well, but three dates may pertain–6119, 5951, and 4400 B.C. These dates are in general agreement with the Oshara dates in the Rio Cuervo and Black Mesa regions. Thus, we can very tentatively date Gardner Springs as between 6000 and 4300 B.C. ± 500 years.

Our next phase, Keystone, is dated better locally although cross-dates to it are poor. We have at least three pertinent radiocarbon dates–3669, 2790, and 2560 B.C.–as well as five obsidian hydration estimates–3434, 3119, 3095, 3057, and 2525 B.C. On the basis of these dates we estimate the phase lasted from about 4300 B.C. ± 500 to 2600 B.C. ± 200. Cross-dates to Deshe may be considered to somewhat confirm this estimate.

For the Fresnal phase we have 20 radiocarbon determinations and one obsidian hydration calculation–a very adequate sample and a good sequence of components, many of which have large samples of artifacts and ecofacts. The radiocarbon dates start with 2350 B.C., which is followed by dates of 2111, 2090, 1910, 1600, 1590, 1510, 1495, 1490, 1360, 1260, 1225, 1140, 1010, 960, 950, 910, and 860 B.C., as well as a poor obsidian hydration calculation of 1100 B.C. Our temporal estimate for the phase as being from 2600 B.C. ± 200 to 900 B.C. ± 100 probably is fairly accurate and tends to be confirmed by cross-dates to Chiricahua, San Jose, and Armijo.

Our final phase, Hueco, is almost as well dated and has much better cross-dating ties with En Medio and San Pedro. In terms of a sequence of dates we have a radiocarbon date, 850 B.C., followed by an obsidian date of 817 B.C., followed by radiocarbon dates of 810 and 600 B.C., as well as two obsidian hydration calculations of 548 and 490 B.C. The middle to late part of the phase has radiocarbon dates of 460, 160, 130, and 125 B.C., as well as A.D. 40, 150, 250, and 380. These dates are confirmed by seemingly accurate obsidian hydration dates of 182 B.C., 138 B.C., and A.D. 187, 244, 260, and 300. These dates allow us to estimate that the Hueco phase runs from 900 B.C. ± 100 to A.D. 200 ± 100.

Now that we have a basic chronology of crucial Archaic phases, it is possible to move on to contextual studies of our excavated components, that is, to reconstruct the way of life followed by the people who occupied the sites at an early period. Then, and only then, can we really attack the problem of the origins of village agriculture in the Jornada region with the wider implications this research has for the Southwest and other parts of the world.

Chapter V

RECONSTRUCTION OF THE WAY OF LIFE IN EXCAVATED JORNADA SITES

R.S. MacNeish and Peggy Wilner

Introduction

Having put our excavated sites–Todsen, Tornillo, and North Mesa–into chronological sequence, we can prepare a contextual analysis, that is, attempt to reconstruct the way of life followed by sequential occupations. As indicated in Chapter II, most of our components were relatively small in size, and few activity areas were readily observable. In our contextual analysis, therefore, we depended heavily on ethnographic analogy–comparing the ancient tools or ecofacts we recovered with those used by modern ethnographic groups–or upon use-wear studies of the ecofacts and artifacts (see Chapter IV, Section 5). On the basis of size of the components and various stratigraphic data, we attempted to estimate size and kinds of groups occupying the shelters and the duration of those occupations, and to determine seasonality from plant and animal remains (see Chapter III, sections 1 and 2). Attempts at reconstructing subsistence patterns are based on ecofacts–edible plant and animal remains, and, rarely, feces–as well as types of tools used to procure and/or prepare those foods. Supplementing this information are data on C13/12 and N15/14 isotopic ratios (see Chapter III, Section 4).

The analysis of each occupational floor was a cooperative effort by our laboratory team. Under the direction of our lab chief, Peggy Wilner, we separated the different materials from each site–lithics, plant remains, bones, and so on. We marked off our lab tables into small squares (usually 25 cm by 25 cm) that pertained to the squares excavated in particular zones and then placed the appropriate specimens dug from that zone in the appropriate square on the table, now representing a specific zone. While MacNeish was doing this, using the square descriptions and their drawings of *in situ* artifacts, Wilner made a packet of notes and drawings for the zone to be studied. We next put together the drawings of each square's artifacts and ecofacts, with their identification or catalogue numbers, to get a complete floor plot for a zone. Then we substituted symbols for the various artifacts and/or ecofacts on the floor plot, using the Cal. Comp. Line plotter (see Figure V-1).

Once the new map of the zone was drawn, we began to study the actual specimens that were laid out square by square, using the analytical interdisciplinary techniques reported in Chapter III. MacNeish identified the lithic types; Dr. Don-ald Chrisman, Peter Dawson, and Wilner identified the bones; Sally Anderson and MacNeish identified the botanical specimens. Following this gross analysis, we studied the artifacts and ecofacts in terms of their use and/or function and made a legend for the floor plot indicating various activities each might have represented.

MacNeish examined each chip with a hand lens and gave those with any semblance of use-wear to Dawson to examine with our Seminov-type trinocular microscope for signs of use-wear. Artifacts showing use-wear were indicated on our maps by circling the relevant artifact or ecofact symbol. A clock-type mark on the rim of the circle indicated the kind of use-wear (see Figure V-1) as identified in Chapter III, Section 6.

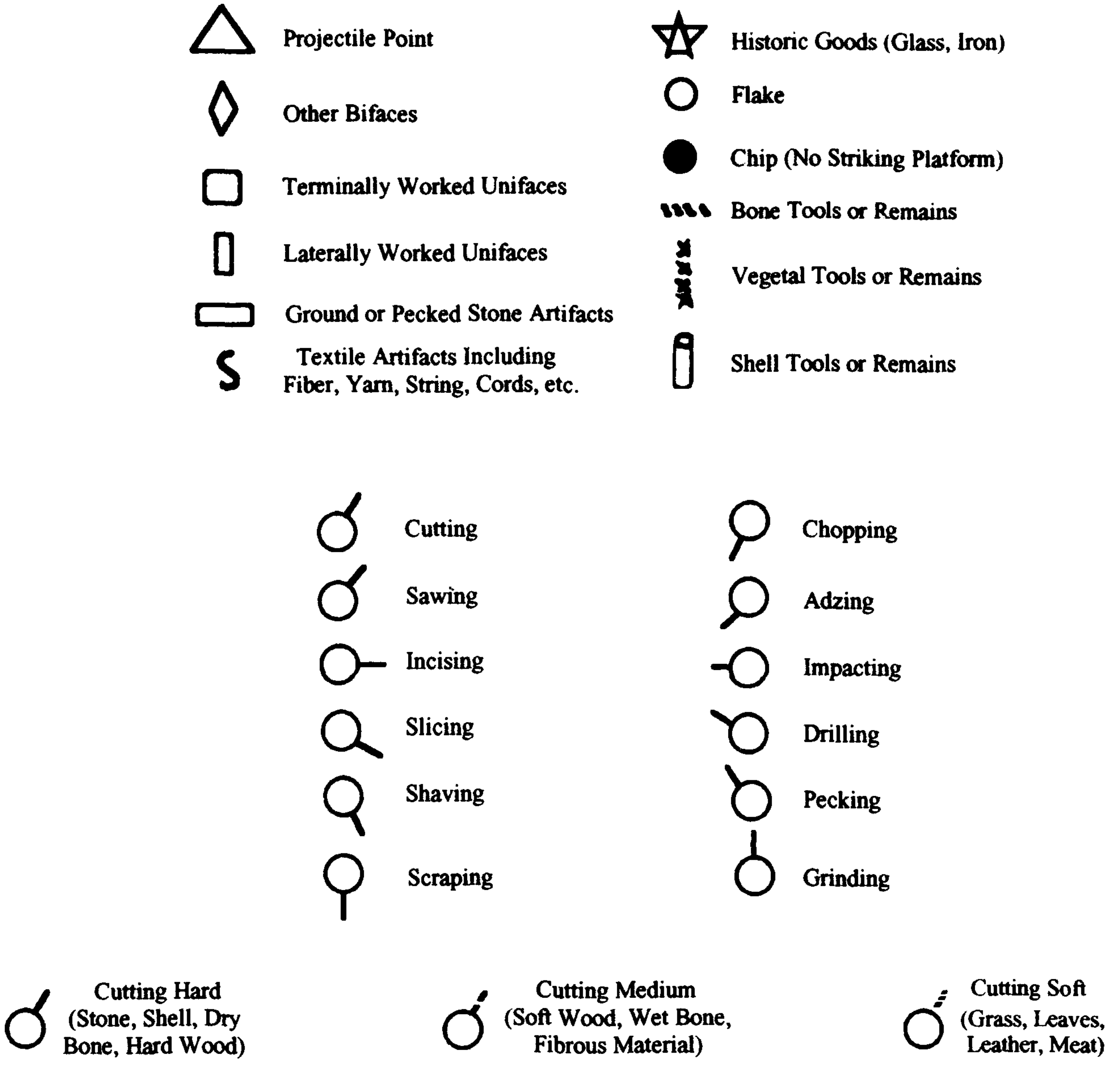


Figure V-1. Key to Symbols Used

Our next step was to interpret what the completed floor plots meant in terms of reconstructing the way of life in a particular zone. First, we considered the plant and animal remains to determine possible seasonality, using the data from sections 1 and 2 of Chapter III. Next, we made rough estimates about the settlement pattern and population by a consideration of the number of hearths and activity areas of the zone. These estimates proved less satisfactory than our consideration of subsistence.

Projectiles and large mammal bones suggested hunting while small animal, bird, and reptile bones, as well as slip loops of string, suggested animal collecting and/or trapping. Bone fragments seemed an indication of butchering, as

did various tools with indications of use-wear–cutting, sawing, slicing, shaving, scraping, and chopping hard. Remains of domesticated plants suggested agriculture and planting, while (on the basis of ethnographic analogy) manos and metates used for back-and-forth grinding seemed to indicate preparation of that food. The presence of wild food plant remains seemed to indicate plant collecting, while mortars and pestles (with pecking use-wear) or milling stones and mullers (with circular grinding or pecking) seemed to indicate preparation of wild seeds and nuts. Various kinds of hearths and ceramics with residue on the interior provided evidence concerning how the occupants cooked their food. In zones that had an associated skeleton, the C13/12 and Nitrogen 15/14 isotopic ratios (Chapter III, Section 4) gave us more inklings about ancient diets and subsistence practices.

Other activities were not so readily discernible, but almost always we found evidence of flintknapping–in the flakes (with striking platforms), chips (without striking platforms), cores, hammerstones, and flakers. Tools that had evidence of working on something medium-hard, whether or not associated with wood tools or chips, gave hints about woodworking; shell or bone in association with tools used for sawing, cutting, or drilling something hard gave evidence of shellworking and/or boneworking. Textiles and tools for working medium-hard fibers hinted at a textile industry, while skins or tools with evidence of cutting, shaving, slicing, and scraping were considered evidence of skinworking.

Evidence of activities on a higher plane were hinted at in the burial practices and in the art, ceremonial objects, beads, paint palettes, and pictographs we found.

Although our reconstructions are unsatisfactory, they provide the basis for future investigators. We will start with our attempts to reconstruct the way of life in the zones of Todsen Cave, our site with the best stratigraphic sequence.

Section 1

The Way of Life Revealed by the Occupations of Todsen Cave

The excavation of Todsen Cave revealed a long sequence of occupations, starting with zone K1 (the Gardner Springs component), which was some 6,500 to 8,000 years old. Reliable contextual data for this zone were found only in the talus slope, and were limited in amount. The following zone, K, covered a large area of the talus slope and possibly connected with zone I inside the cave. It was of the Keystone phase, roughly 4300-2600 B.C., and had more artifacts and ecofacts than zone K1, allowing for a fuller reconstruction. However, since these materials, as well as those of zone J1, were tumbled downslope, we did not illustrate them with floor plot drawings.

The following Fresnal occupations, 2600-900 B.C., occurred both in zone J1 downslope and in zone G inside the cave, as well as overlying zone J and corresponding zone F inside the cave. In addition to still more artifacts and ecofacts, this Fresnal occupation contained burial 8. Our fullest data, however, relate to the final Archaic phase, Hueco, 900 B.C.-A.D. 250. This phase includes many ecofacts and artifacts from the rich talus zone πJ, data from zones E, E1, and E2, and burials 4 and 6 from inside the shelter. Study of the material remains indicates the Archaic phases in Todsen Cave are seasonal microband occupations only, mainly occurring during the spring. They do, however, represent a major proportion of the total culture complex.

The later, Ceramic phase occupations provide a much smaller glimpse of their culture periods. Zone D2 of the pithouse village Mesilla phase, A.D. 250-900, had few artifacts and ecofacts and provided only a glimpse of transients passing through Spring Canyon and briefly pausing in Todsen shelter. The puddled clay floor, zone D1, also represents spring transients, but the material remains are so few it is difficult to tell if they were of the Doña Ana or El Paso phase. Sherds in zone D and in F+, the corresponding downslope zone, show it to be of El Paso phase, between A.D. 1100 and 1250. The limited remains, however, only allow us to identify the way of life of spring transients whose main cultural activities occurred in a large sedentary pueblo, although C13/12 and N15/14 isotopic analysis of four burials yields new insights into their sustenance.

Overlying zone C, A.D. 1625 and 1675, is of a meagerly represented Proto-Historic phase; its burial hints at an Apache occupation. Zone B, when the cave was used as a corral from A.D. 1850 to 1910, was of the general Historic period, and zone A was of modern times and even less instructive.

Although meager, these data give us solid information about the way of life of the people who occupied Todsen Cave during the springtime. When combined with data on the summer occupation at Tornillo Cave; the summer, fall and winter occupations at North Mesa; and the fall occupations at Fresnal Cave; they help fill out the Archaic picture and allow us to test hypotheses about the beginnings of village agriculture in the Southwest.

The following paragraphs describe the way of life occupants of Todsen Cave seemingly followed.

The Way of Life of Zone K1

At the east-west center of the talus pit, the north edge of our excavation, was a thin light-brown stratum, zone K1, over the sands (zone M) and gravel (zone N) of the high terrace and under the orangish zone K. It never was more than 20 cm thick and covered an area of only 8 to 10 m^2. In the center in N3W1 lay a heavy concentration of burned rock and charcoal (which never has been dated because of possible rodent contamination). The stratum is relatively level and may represent a brief occupation by a small group. Whether it connected with any stratum inside the shelter, such as zone I, is impossible to tell. Crane leg bones included among the animal bones suggest spring occupation; the limited remains suggest a single occupation rather than a series.

Bones of a couple of deer and an antelope and many individual bones of rabbits and small mammals represent meat eaten. A crude Jay-like point and an Abasolo with a tip snapped by percussion probably were altatl dart points used in the hunt. What implements were used to collect or trap the smaller animals is unknown. Much burned bone indicates cooking of meat, and areas of charcoal and fire-cracked rock may represent the hearth used.

The majority of artifacts, particularly those showing use-wear, seem to be connected with the butchering of those animals. Most numerous were artifacts with nicks or scratches from shaving or slicing something hard; these included two cleavers, two large convex retouched unifaces, a single blade, a flake, a half-moon biface, and a concave retouched uniface. Almost as numerous were lithic unifaces with nicks from cutting something hard–three denticulated sawlike unifaces, two large unifaces, and one convex retouched uniface. Tools used for scraping against something hard included six large denticulates, two snub-nosed end scrapers, and a pebble scraping plane.

Eight tools–four large ovoid disks, two pebble choppers, and two cleavers–were used for chopping, but whether they were used to chop hard wood or struck bone in meat is difficult to tell. A large crude blade may have been used for chopping meat.

A number of tools–three blades, two large and two small convex retouched unifaces, three flakes, and one small concave retouched uniface–also were used to scrape or shave something medium-hard, and a flake was used in sawing. These tools seem to have been used on wood rather than skins although one snub-nosed end scraper does show evidence of scraping hides. In fact, it looks as if, in addition to butchering, the major industry was woodworking, perhaps making the shafts and other parts of weapons used in the hunt.

Certainly making tools was a major activity during this sojourn, for three cores, an antler flaker or hammer, a pebble hammer, 101 flakes, and 129 chips were spread over the area of zone K1. The material used was mostly the local nearby rhyolite; a couple of chips were obsidian, and a few tools were chert.

The only other activity of which we have evidence is seed grinding, from a pebble muller and a boulder anvil mortar and milling stone. Although the evidence is slim, it would seem that in this Gardner Springs occupation hunting and animal collecting were more important than seed or wild plant collecting.

Obviously we need more information to test this hypothesis and fill out our knowledge of the Gardner Springs way of life. Excavated components of this period from North Mesa had even fewer artifacts, and Peña Blanca and Fresnal had only hints of an occupation during this time period. Fresnal, however, did yield dates of 5951 and 6119 B.C. (Carmichael 1982), as well as a Bajada point that may pertain to this horizon.

The way of Life of Zone K

Zone K, often described as orangish brown, contrasted with dark brown zone J1, or brown zone J, which overlay it. Much of zone K overlay the green rock fill, zone L or X, but along its northernmost edge it lay over a thin charcoal-filled orangish layer (zone K1) or the sand (zone M) or gravels (zone N) of the high terrace that extended into the cave. Although zone K leveled out along the north (N3) edge of our excavation, where it reached a maximum thickness of about 40 cm in a few spots, much of it sloped at about 45° on top of greenish rock fill to the south, and pinched out at about the N1W2 point. Zone K thus covered only a half-moon-shaped area of about 11-13 m^2 and gave the appearance of having been dumped out of the interior of the shelter, perhaps from the pit (zone H) or the 3 m^2 ash floor under the pit (zone I) in the interior center of the shelter. Unfortunately, we have no dates on zone H or I to compare with zone K's radiocarbon date of 3669 B.C. or its obsidian hydration date of 3440 B.C. Moreover, the seven chips and bone flakes from zone H or I fail to tell us whether the artifacts were of the Keystone phase, like those from zone K.

The bones uncovered from zone K suggest a series of spring-summer occupations that, judging from the area of zones I and K, probably were brief stays by a small group–a task-force or family microband–who camped near the spring either on their way to somewhere else or as part of a seasonal scheduled subsistence system.

In terms of later occupations of the Fresnal and Hueco phases, while bones of small mammals (often jackrabbits) still are dominant, the proportion of deer bones is relatively high. Strangely enough, however, the proportion of projectile points to bones is relatively low. We found parts of three Amargosa-Pinto points, a Bat Cave, a Gypsum-Almagre, a Todsen, and a possible Jay (the last perhaps dug up from an earlier level), as well as a large body fragment. We might speculate that hunting was slightly less important than collecting or trapping small animals.

Although we have no human skeletons from this horizon, a C13/12 analysis of a possible contemporary skeleton from nearby Chavez Cave gave a reading of about 20, suggesting meat was dominant over wild (Cam or C3) plants. The preponderance of tools uncovered with use-wear suggest the occupants were butchering. Seven artifacts–three

cleavers, two bifacial knives, a large disk, and a convex uniface–as well as three large flakes, show evidence of chopping something hard, such as bone. Artifacts showing evidence of scraping against bone as they were used to plane off meat are even more numerous and include five large denticulates (that also could have been used on hard wood), four large flake end scrapers, two small retouched flakes, a snub-nosed one, a corelike tool, and a flake. Tools showing evidence of nicks from cutting, shaving, or slicing something hard are even more numerous. Cutting tools included nine denticulate saws, four large concave unifaces and a convex uniface, an unretouched flake, three small and two large convex unifaces, two large concave unifaces, a crude blade, and small concave unifaces.

We also found some charred seeds and grinding tools, including five anvil mortar-milling stones, three boulder milling stones used on one surface, and as many others used on two surfaces. Less numerous were the hand stones–a pebble muller, a discoidal muller, and an elongate pebble mano–used to grind (wild) plants on receptacle stones. Our guess is that all the plants worked were wild, but more study and evidence are needed in this area.

Connected with the butchering activities were tools that seem to have been used in preparing skins or cutting soft wood or fibers, probably the latter, for we found no end scrapers that showed evidence of cutting soft items, although two nebulous flakes showed such use. Four flakes, however, showed evidence of shaving and/or slicing soft things like skins or meat, as did five small convex and one small concave retouched uniface. Three crude blades and a large retouched convex uniface showed evidence of cutting or whittling (six showed no use-wear); and a sinew stone and an abrader could have been used against wood or hides.

Evidence of boneworking consisted of two pieces of polished bone and four tubular bone beads; some of the butchering tools could have been used on them, particularly the blades that had evidence of sawing bird bone.

Another major activity was making the above-mentioned tools during the brief sojourn in the shelter. Mainly of local rhyolite were 671 chips, 513 flakes, and five cores. Associated with them were three pebble hammers, an antler flaker, an Abasolo point, and three bifacial knives that also could have been quarry blanks.

Aside from this occupation at Todsen, little is known of the Keystone phase from other excavations in the region.

The Way of Life of Zone J1 and (perhaps) Zone G

Zone J1, representing the Fresnal phase, was light brown in texture, often sandy, and speckled with charcoal. It occurred well down the slope (about North 2) and covered about 12-14 m^2, overlying the distinct orangish zone K to the north edge of our excavations, where zone J1 attained a maximum thickness of about 30-40 cm. Its surface was relatively level, at about 20° below horizontal, but its base that capped zone K was 30-40 cm below the surface. Zone J1 could have been an occupation area outside the cave and north of the dripline, but we suspect it represents refuse that poured out from either the small thin patch of zone G (under zone F in the east part of the cave) or from part of lower zone F, which also contained artifacts of the Fresnal phase. A piece of charcoal in a burned patch that might be a hearth gave a radiocarbon date of 1490 B.C., while a nearby piece of obsidian yielded a hydration date of 1100 B.C. Analyses of wild animal bones suggest a spring-summer occupation or series of occupations. Although zone J1 is relatively long–7-8 m east-west–it is relatively narrow (less than 3 m), suggesting the occupations probably were by small transient groups, such as task forces or family microband(s) who made a brief stopover at Todsen Cave and its nearby spring.

The association of a few deer bones with three Armijo points, an Augustin, a Chiricahua, a Pelona, a Nogales, a Todsen, and a Jay and Lerma (the last two possibly from earlier levels) indicates some hunting occurred during the brief Fresnal phase sojourns. It should be noted, however, that the bones of small mammals, particularly jackrabbits, far outnumber those of deer, so trapping or collecting of animals probably was as important an activity as hunting.

A few grass and creosote seeds and numerous grinding stones–a boulder milling stone, mortar-anvil, bifacial and rockered metates, a pebble muller, and three elongate pebble manos–suggest wild plants had been more numerous in the people's diet than meat. Probably all these grinding stones were used on wild plants: the hand stones are not heavy enough to pulverize hard corn kernels, and the Fresnal sojourns contain no evidence of the use of domesticates or of horticulture and/or agriculture.

Far outnumbering artifacts for preparing plants are those seemingly connected with butchering–four different types of bifaces (two cleavers, a pebble chopper, a large ovoid disk and a flake chopper), as well as a large flake and a

back-blunted uniface that showed use-wear of chopping something hard, like bone. A few tools–a large flake end scraper, a pebble scraper plane, a large plano-convex disk, and five large flakes–had scraped against something hard. More numerous were tools showing evidence of cutting or sawing something hard–two denticulated saws, a flake, a large convex uniface, and three crude blades–as well as tools showing evidence of shaving and/or slicing–seven flakes, three large convex and two small convex unifaces, and two large and one convex uniface.

Some of these tools might have been used on very hard wood, but we have no evidence for such use. The evidence for working soft wood, such as gouges and convex or spokeshavelike unifaces, is difficult to distinguish from that of working skins, which I believe was an important activity because of the numerous bones of fur-bearing animals. A thumbnail or small flake scraper and a large convex uniface definitely seem to have been used to flesh hides, while the numerous (seven to ten) crude blades could have been used to slice them, as might two flakes and four convex unifaces with similar use-wear. Flakes also were employed for cutting something soft; and use-wear evidence indicates both large and small convex unifaces were used to perform the same task. Last but not least is a sinew stone that could have been used to make thongs. Three leaf-shaped bifacial knifelike blades could have been used for cutting, for butchering, or in boneworking along with a large pointed flake. Three tubular bone beads, one notched, as well as polished bone, indicate boneworking.

As might be expected, many of these tools were manufactured *in situ*, probably as they were needed. Evidence of flintknapping includes five cores (four of local rhyolite), two hammerstones, an antler flaker, and more than 597 chips and 377 flakes, most of local materials.

We suspect many other activities were carried on by the visitors to the shelter during the deposition of zone J1. The evidence we do have helps fill out the picture of the way of life Fresnal peoples followed during the middle of the second millennium before the time of Christ. It also supplements our knowledge of the Fresnal phase occupations in zones F and J of Todsen Cave, as well as in zones D, C, and B of Tornillo Rockshelter, features of zone B at North Mesa, and in La Cueva and Fresnal itself, which certainly are of different seasons and probably had different scheduled subsistence systems.

The Way of Life of Zone F and Downslope Zone J

The east-west profile, particularly along the W1, W2, and W3 profile, shows that the 5- to 15-cm layer of charcoal-filled refuse of zone F (see Figure V-2) connects at the dripline with the thin layer of brown refuse, zone J, that thickens to 1m as it goes downslope. Further, the small bifacial disks, rockered manos and metates, gouges, and Todsen points found in both zones F and J suggest both are of the Fresnal phase. For zone J, we have a number of radiocarbon dates–860, 910, 930, and 960 B.C.–that fit the Fresnal time period. Unfortunately, we did not have adequate charcoal samples from zone F to submit for dates. The bones from both zones suggest the numerous cave visits that formed zones F and J probably occurred predominantly in spring and summer. Whether these visits were by microbands or macrobands is hard to tell, but I favor the latter.

The artifacts from the relatively level stratum in the interior of the cave in zone F were far less numerous than those of zone J, and their types suggest the possibility that zone F represents a long period, perhaps starting even before Fresnal and being contemporaneous with earlier zones J1, K, and K1. Zone F, however, had none of the diagnostics of the Keystone and Gardner Springs phases and overlay zones G, H, and I, which seem stratigraphically more connected with zones J1, K, and K1, even though the former had few (diagnostic) artifacts in them. The relative richness of downslope zone J and the relative thinness and lack of artifacts of zone F suggest that not only were the occupants of zone F dumping their refuse downslope, but actually performed activities such as grinding foods, butchering, and flintknapping on the talus in the sunlight rather than occupying the cooler and darker interior of the shelter.

In fact, one of the important activities of these occupations–hunting–is represented only by a mountain sheep rib, deer bones, and a side-notched (Todsen?) point fragment in zone F. In contrast, zone J literally had hundreds of big mammal bone fragments and many deer bones, as well as a few bones of puma and antelope in association with many projectile points, including fragments of three Augustin, three Todsen, two San Jose, and single fragments of La Cueva, Fresnal, Armijo, and Nogales points, as well as a large broken tip and body. Five Abasolo types occurred, but we suspect most were quarry blanks, for none had snapped tips like those previously mentioned.

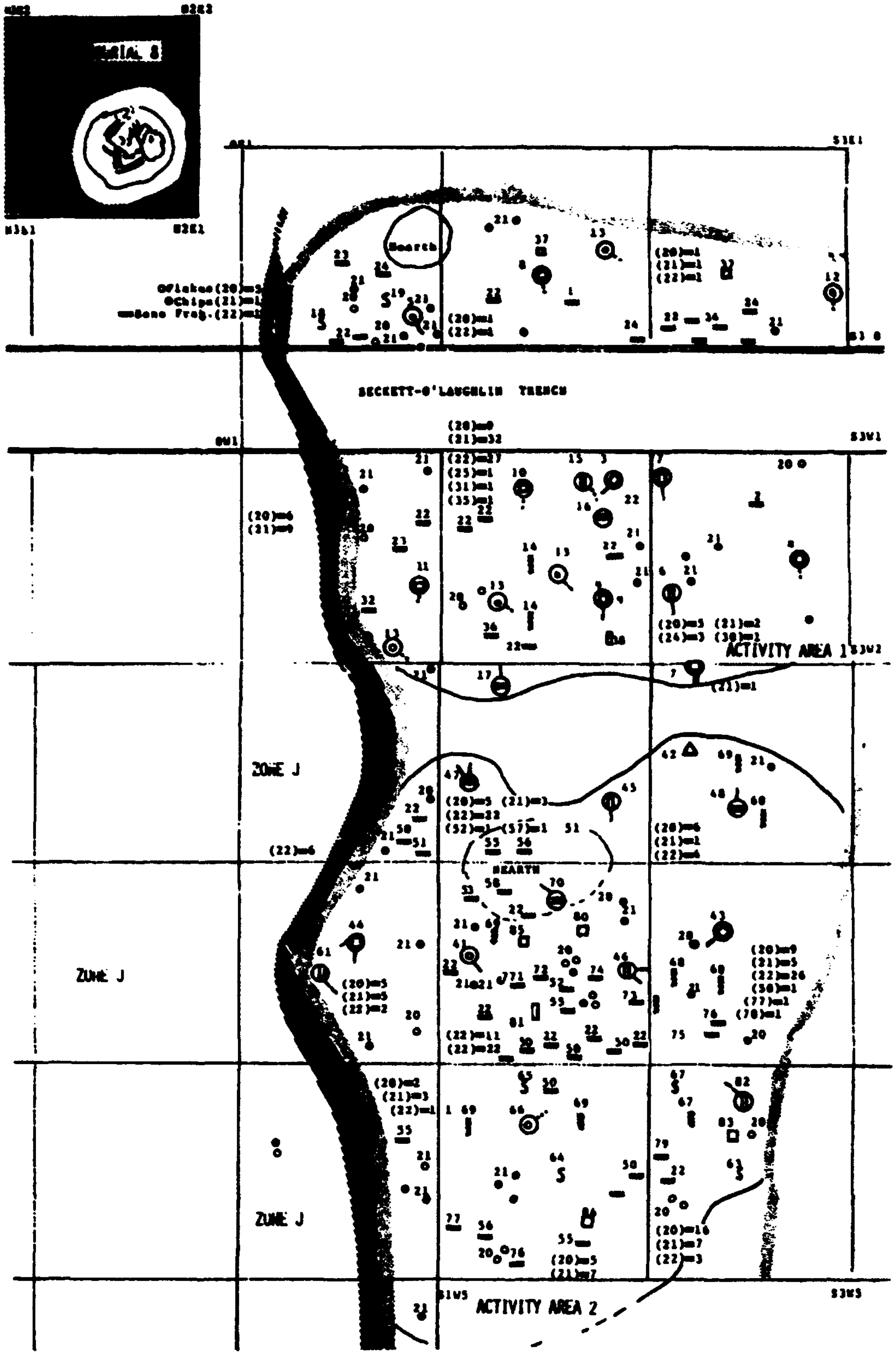


Figure V-2. Todsen Cave: Floor Plot of Zone F, Fresnal Phase

LA5531
Zone F
Phase: Preemal
C14 Dates: 960 to 860 B.C.

Activity Area 1
Seasonality: Spring-Summer - Crane (1), Reptile (2)
Settlement Pattern: 1 hearth = Microband

Activity*	Type of Use-Wear	
Butchering		
Small Bifacial Disk (3)	Chopping	Hard
Large Denticulate (4)	Scraping	Hard
Flake (5), Large Convex (6), Small Convex (7)	Slicing	Hard
Hunting		
Bones		
11 Fragments (22)		
Deer Metacarpal (23), Deer Tooth (24), Patella (25)		
Collecting		
Mouse Scapula (34), Rodent (35), Rodent Metacarpal (36), Rodent Skull (32), Rodent Femur (33),		
Jackrabbit Ulna (30), Radius (31)		
Plant Collecting		
Ovoid Rocker Mano (16)		
Boulder Anvil (17)		
Skinworking		
2 Thumbnail (8), Gouge (9), Scraper Plane Flake (10), Plano Convex Disk (11), Flake (12)	Scraping	Soft
3 Flakes (13)	Slicing	Soft
Woodworking		
2 Sticks (14), Blade (15)	Shaving	Soft
Textileworking		
Yucca Coil (18), Quid (19)		
Flintknapping		
30 Flakes (20)		
72 Chips (21)		
Unused Tools		
2 Gouges (37), 1 Blade (38)		
Burial 8 in Zone J - Flexed - No Grave Goods		

Activity Area 2
Seasonality: Spring-Summer - Gourd (60), Seeds (69)

Activity	Type of Use-Wear	
Hunting		
Todsen (?) Point (42)		
Butchering		
Small Bifacial Disk (43)	Chopping	Hard
Plano Convex Disk (44), Large Convex (45)	Scraping	Hard
Backblunted Knife (46), Flake (41)	Slicing & Incising	Hard
Bones - Rodent Maxilla (50), Scapula (51), Skull (52), Metacarpal (53), Rib (54), Femur (72), Ulna (74); Jackrabbit Maxilla (55), Scapula (56), Skull (57), Mandible (58), Rib (75), Humerus (78) Femur (79); Prairie Dog Mandible (71); Cottontail Maxilla (73); Mouse Rib (76), Mouse Maxilla (77)		
Plant Preparation		
Rocker Mano (48)	Grinding	Hard
Boulder Rocker Metate (47)	Grinding	Medium-Hard
Plant Collecting		
Cut Gourd or Cucurbita (60), Yucca Square Knot (63), Coil (64), Yucca Loop (65), Cord (67), Yarn (68), Seeds (69)		
Blade (61), Flake (66)	Slicing	Medium
Skinworking		
Large Pointed Flake (82)	Drilling	Medium
Flintknapping		
52 Chips (20)		
37 Flakes (21)		
1 Core		
1 Pebble Hammer (70)		
Unused Tools		
Small Flakes (80)		
Denticulate Saw (81)		
Plano Convex Disk (83)		
Large Flakes (84)		
Gouge (85)		

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-2. continued

In zone J, the bones of small mammals far outnumbered those of big mammals, so collecting and/or trapping probably was a more important activity than hunting. Also, in the concentration of refuse in the western part of zone F–activity area 2–we found a yucca loop with a slip knot in it and a small stick with a groove around one end that could have been part of a snare-spring trap, in association with bones of prairie dog, cottontails, and jackrabbits.

At the cave butchering the dead animals seemingly was a major activity during all occupations in activity area 1 (covering 3 m^2 to the east), and activity area 2 (covering 8 m^2 to the west) on the floorlike zone F, and in the downslope zone J. In each we found tools with use-wear evidence of chopping something hard, such as bone, a small bifacial disk in activity area 1, a pebble chopper in area 2, and two large bifacial disks and a flake chopper as well as blunted semi-lunar bifaces in zone J. A number of objects in each activity area also have nicks, indicating they had scraped against something hard or had struck bone in scraping off meat; these tools included a domed scraper plane and a large concave uniface in area 2, a large denticulate in area 1, four large flakes downslope in zone J, five denticulates, three gouges, two large flake scraper planes, a flake end scraper, and a pebble scraping plane. Also probably connected with butchering was a series of tools used for slicing or shaving something hard, such as removing the meat from bone; these include a flake, a large and small convex uniface in area 1, a back-blunted uniface in area 2, two large convex unifaces, a flake, and a large convex uniface in zone J. The only other tools that might possibly have been used in butchering–three flakes, two convex unifaces, two denticulated unifaces, and a crude blade–came from zone J.

All of these tools would seem to indicate meat was a major part of the diet; however, our C13/12 analysis of skeleton 8 gave us a reading of -16.5, while the N15/14 reading was +7, suggesting plants far outnumbered meat in the occupants' sustenance. While we found some grass seed and mesquite seed in activity area 1, and a few burned seeds in activity area 2, tools inferring plant collecting were rare, although a square knot of a yucca strand in activity area 1 may have been part of a carryloop for bringing leafy plants back to the cave. In the plant or seed preparation line were a single ovoid rockered mano and a boulder anvil in area 1, a rockered mano and metate in area 2; downslope were three milling stones associated with three pebble and discoidal mullers, two slab metates, and two elongate pebble manos, as well as two boulder rockered metates associated with a single ovoid rockered mano. Many of these grinding tools in the talus were found lying horizontally, and 15 of them were concentrated in the upslope part of zone J, suggesting the actual grinding was done out in the sunlight at the top of the talus.

In terms of artifacts or ecofacts from zones J or F, no evidence exists of the use of domesticates at this time even though such use occurred at such nearby sites as Tornillo and Fresnal. Although cucurbit rind fragments did appear in area 1 of zone F, the isotopic analysis of burial 8 gave no evidence of the use of domesticates and/or horticulture at this time, so the cucurbits probably were a very minor supplement to the seasonally scheduled collecting activities.

Another major activity during the deposition of zones F and J was the toolmaking, often connected with the subsistence activities just mentioned. Area 1 of zone F contained but 30 flakes and 72 chips, while area 2 yielded 52 chips, 37 flakes, a core, and a pebble hammerstone. Downslope in zone J, however, evidence of toolmaking was abundant, with 1,182 chips, 1,115 flakes, five cores, three pebble hammerstones, and five quarry blanks called Abasolo points. About 85 percent of all these flintknapping products were of rhyolite, probably from nearby Picacho Peak. The ground stone tools probably were made from pebbles and cobbles taken from the stream in front of the cave; however, we lack real proof of their manufacture at the site.

Determining the next activity is a little more difficult in terms of use-wear, for the polish made in scraping skins and cutting soft wood often is difficult to differentiate on rhyolite tools. We do have four or five pieces of cut or whittled wood and a whittled pointed stick in zone F, but that zone also has a number of end scrapers that more likely were used on skins than on wood. Activity area 2, however, had three gouges suggesting woodworking, as well as large convex unifaces with evidence of scraping something soft, a denticulated saw, and a flake and blade that show shaving use-wear on something medium-soft, like wood or hides. The evidence for woodworking also is abundant downslope in zone J, where only one snub-nosed scraper good for scraping skins occurred–and it may well have been brought up from an earlier level. The most abundant artifacts that have evidence of slicing or shaving skins or, more likely, soft wood are the large (eight) and small (seven) convex unifaces; five blades and four flakes show similar use-wear evidence, as do a large concave uniface, a denticulate, and a large pointed uniface. Only a single blade shows evidence of cutting or sawing soft materials. Zone J has five sinew stones, and the grooves in these could have been used to "sandpaper" wood or thongs.

Although activity area 1 of zone F had two cut sticks in it and similar artifacts to those in area 2, its thumbnail end scraper, gouge, a flake, and its plano-convex disk show evidence of scraping something soft, leading me to speculate the tools were used for working hides. Three other flakes and a blade, which show evidence of shaving something relatively soft, could have been used to shave hair off skins.

In both activity areas 1 and 2 of zone F we found string, cord, a quid, yucca strands, and a yucca coil of strands indicating stringmaking and perhaps the making of some sort of textiles. Downslope was a piece of polished bone and some bone beads, both notched and unnotched, suggesting a boneworking industry.

Zone J also yielded evidence of one other important activity that was of a ceremonial nature, namely, burial 8. It was most peculiar, for it was the skull and flexed upper part of the body of an adolescent (possibly female), laid on its left side and facing north. What happened to the legs is unknown; perhaps this half a body represents a secondary burial or some sort of reburial. Its placement in a cylindrical pit about 30 cm deep and in diameter is unique and hints that some sort of rites and rituals accompanied its interment.

The Way of Life of Zones E, E1, E2, and πJ

Zone E, within the shelter itself, clearly is distinguishable from the overlying zone D and underlying zone F with their refuse and charcoal-darkened soil, for zone E mainly is (zone E1 excepted) horizontally bedded, grayish to orange scree–small stone flakes that probably fell from the ceiling of the shelter. It covered about 17 or 18 m^2 (see Figure V-3), and to the south pinched out between charcoal layer zone F and brown zone D2, while to the north toward the talus, it blended into and became zone πJ. At about S2W2 zone E reached its maximum thickness of about 25 cm; just to the east of this point in five squares was a thin (2-5 cm) layer of charcoal, zone E1, within which most of zone E's artifacts occurred. Zone E1 thus divided the layer into two scree parts: a thicker, upper portion of about 10-15 cm in thickness (zone E) and a lower portion of 2-5 cm (zone E2). At the dripline the zone E1 layer expanded and blended into the dark brown zone πJ, which underlay the darker and more friable zone F+, which contained ceramics and overlaid the thinner and more orange zone J.

Not only did zone πJ have many more artifacts and ecofacts than zone E, but it was not horizontal, sloping down the talus at about a 45° angle and thickened from the 20 cm or so of zone E at the dripline to more than 1 m downslope at the north end of our excavations. From the standpoint of soil contents and thickness it would appear zones E and πJ were not connected, but four reasons suggest they were.

1. The north-south profiles, particularly those at W1, W2, and W3, showed that zone E blended into zone πJ at the dripline.
2. Dates show these zones are contemporaneous. Burial 6, which came down from E2, had a radiocarbon date of 850 B.C., while lower zone πJ had C14 dates of 810 B.C. as well as obsidian dates of 817 B.C. and 490 B.C. Burial 4, dug down from zone E, was dated at 600 B.C., while a nearby obsidian chip in zone πJ dated at 548 B.C., bones from upper zone E were radiocarbon dated at A.D. 150, and a chip from the top of zone πJ was dated A.D. 187.
3. Part of a domed scraper plane from zone E1 could be fitted together with a base from zone πJ.
4. Finally, the artifact complexes of both zones had gouges, small pointed unifaces, small disk end scrapers, and domed scraper planes in common, showing both zones are of the Hueco phase.

This information leads to our interpretation that the major occupations in the shelter occurred in zone E, on floors such as zone E1, and that the inhabitants mainly dumped their refuse downslope. The refuse then was leached and/or matured by moisture or rain falling on these soils to form zone πJ. Further, some of these Hueco occupations, or parts thereof, probably were not in the shelter itself, but on the talus with added artifacts, ecofacts, and refuse of zone πJ.

As the dates indicate, the occupations in zones E and πJ spanned most of the extent of the Hueco phase from 850 B.C. to A.D. 250. They probably occurred in many seasons, but the majority of the bones, including those of cranes, as well as grass seeds, indicate spring or summer visits to the cave were the most numerous. A single burned area in zone E1, with a limited extent, and but a single hearthlike area in zone πJ suggest the size of the Hueco groups visiting the cave was small, that is, microbands and/or task force groups.

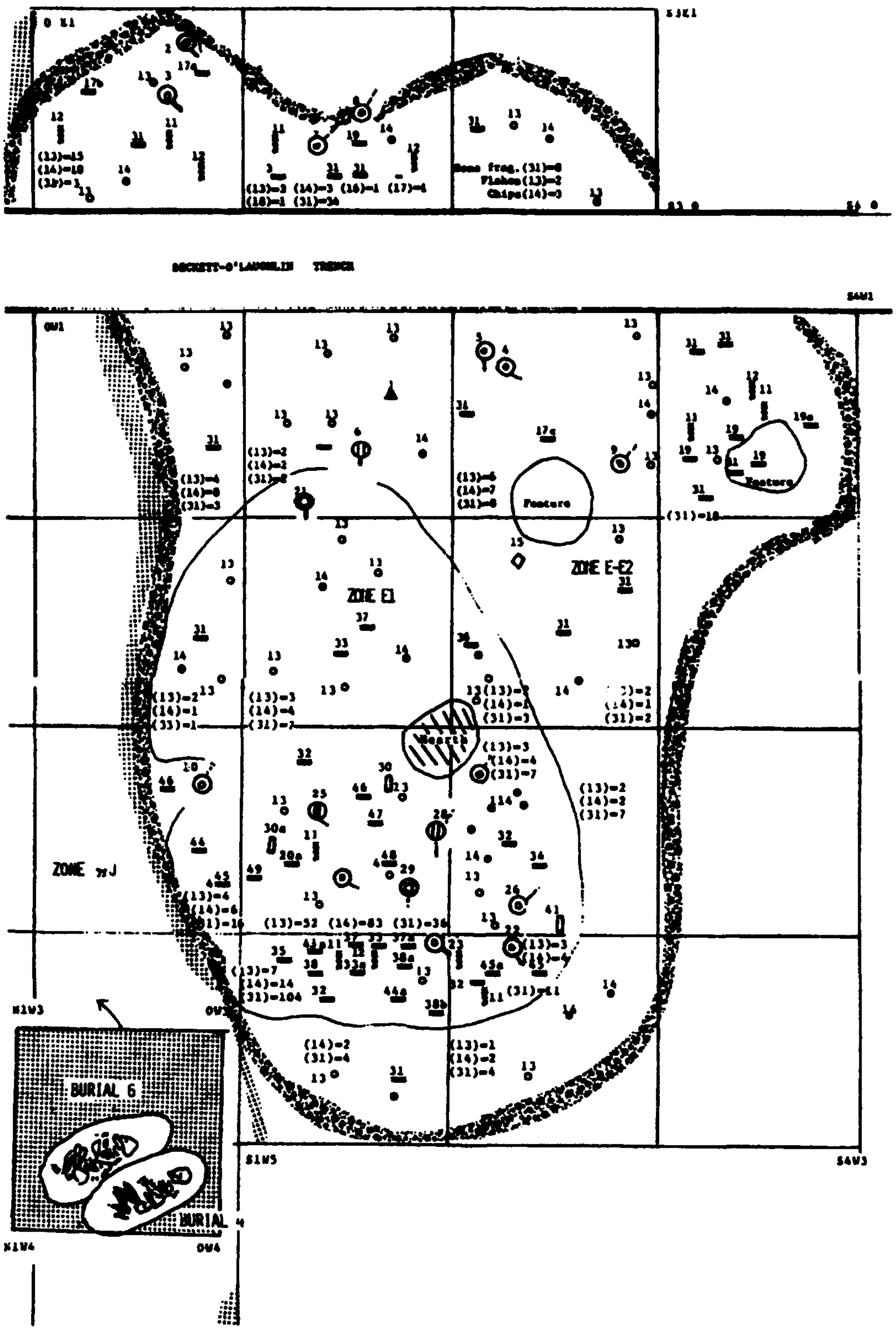


Figure V-3. Todsen Cave: Floor Plot of Zones E, E1, and E2 and Downslope πJ, Hueco Phase

LA5531
Zone E, E1, E2 (πJ)
Phase: Hueco
Date: 850 B.C. to A.D. 187

Zones E-E2
Seasonality: Wet Season – Turtle
C14 Date: 850 B.C.
Settlement Pattern: 1 Hearth – Feature 5
Storage Pit = Microband or Task Force

Activity *	Type of Use-Wear	
Hunting		
Atlatl Tip (1)	Impacting	Hard
Deer Femur		
Butchering		
Flakes (2, 3, 4)	Slicing	Hard
Flake (5), Large Concave Uniface (6)	Scraping	Hard
79 Bone Fragments (31)		
Collecting/Trapping		
3 Jackrabbit Humerus (19)		
Rodent Scapula (16), Metacarpal (17), Innominate (17a), Femur (17b), Mandible (17c)		
Mouse Femur (18)		
Woodworking		
Wood Chip (11)		
Flake (7, 87, 2)	Shaving	Medium
Flake (10)	Cutting	Medium-Soft
Plant Collecting		
Tornillo Seed (12)		
Flintknapping		
22 Flakes (13)		
42 Chips (14)		
1 Core (15)		

Ceremonial Burial 6 – Flexed Adolescent in Shallow Pit Covered by Rocks – No Grave Goods

Zone E1
Seasonality: Spring-Summer – Crane (20), Reptile (20a)
C14 Date: 600 B.C.
Obsidian Hydration Date: 548 B.C.

Activity	Type of Use-Wear	
Butchering		
Gouge (21)		
Flakes (22, 23, 24)	Scraping	Hard
Large Concave Uniface (25)	Slicing	Hard
225 Bone Fragments (31)		
Animal Collecting and/or Trapping		
Rodent Skull (37), Radius (32), Maxilla (33), Humerus (45), Scapula (44), Calcaneum (38), Mandible (33a), Skull (37a), Rib (38a), Metacarpal (38b)		
Mouse Radius (36), Metacarpal (43), Femur (47)		
Jackrabbit Metacarpal (34), Femur (46), Ulna (35), Rib (44a), Skull (37), Humerus (48), Tarsal (49)		
Bird (43a)		
Prairie Dog Mandible (46)		
Wood, Fiber and Skins		
Flake (26, 27)	Cutting	Medium
Domed Scraper Plane (29)	Scraping	Soft
Large Convex (28a)	Cutting & Scraping	Soft
Small Pointed Uniface (30)	None	
Back Blunted Uniface (30a)		
Flintknapping		
102 Flakes (13)		
65 Chips (14)		
1 Core (15)		

Ceremonial Burial 4 – Flexed (Male) Adolescent in Shallow Pit with a Sash of 257 Notched Bone Beads – Covered by Slabs

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-3. continued

Evidence for subsistence activities is meager within the cave in zone E with only a fragment of a large, thick projectile tip being uncovered. Downslope in zone πJ, however, we have many point fragments, including not only four tips and bodies of large points, but three Hatch, three Hueco, and three San Pedro large points, as well as one En Me-

dio, one San Pedro small, two Nogales and four Abasolo (the last two types of which may be knives or quarry blanks). Most of these points had their tips snapped off by impact, suggesting they served as projectile points. Their association with deer bones suggests hunting was a major activity during the Hueco occupations, which is not too surprising since some occupations took place in the spring dry season when deer were forced to use the nearby spring and would have been easy to kill by occupants in Todsen Cave.

As with the later occupations, jackrabbit and small mammal bones outnumber those of the large animals and hint that these small animals probably were more important in the people's diet than meat from larger animals. The C13/12 and N15/14 analyses of the bones of burial 4 and 6 indicate, however, that meat as such was a minor part of the diet and Cam or C3 plant remains were of much more importance.

Nevertheless, we found little evidence of use of plants in zone E, though a couple of flakes appear to have been used to cut fiber (or soft wood). Numerous ground stone tool remains were found downslope, including two pebble mullers, seven elongate pebble manos, an anvil and/or mortar stone, and unifacial boulder milling stones. All probably were used to grind wild seeds, which we found in zone E1. Other grinding stones, including rockered manos, a small rectangular mano, and boulder and slab metates, probably also were used to process wild seeds, and a single trough metate could have been used for grinding corn. The figures of -15 and -14 for C13/12 analysis on burials 6 and 4, respectively, tend to confirm the hypothesis that the diet consisted predominantly of wild plant remains with some meat and only a hint of domesticates.

Though plants may have been a major part of the diet, the tools mentioned above are far outnumbered by bones, as well as by chips that seem to have been used in butchering. Evidence in zone E within the shelter was limited to a few bones, broken and scratched, of jackrabbit, mice, and deer in association with a gouge showing evidence of scraping something hard and four chips used for slicing something hard. Downslope in zone πJ, however, was abundant evidence of butchering. In fact, the host of scrapers with evidence of "scraping hard" included six gouges, four small flake end scrapers, three large flake end scrapers, two large denticulates, two to four plano-convex disks, as well as about 20 flakes with similar use-wear. Also downslope were three areas with tools showing use-wear of hard scraping, but whether these areas are a result of dumping butchered refuse downslope or of the people butchering while seated on the talus is difficult to tell. Some of the tools could have been used to work hard wood rather than hard bone, which is true of five kinds of choppers with evidence of chopping hard surfaces–three pebble choppers, a cleaver, a large disk, a core, a small disk, and a domed scraper plane. Other artifacts that showed evidence of cutting hard objects are 18 flakes, one large convex uniface, and a denticulate. Many other unifaces show evidence of "slicing hard objects"–seven large convex, 11 large concave, one small convex, and one small concave uniface. One showed evidence of drilling something hard, like bone, but this tool may have been used for making beads rather than butchering.

From this evidence we can conclude that a major activity in Todsen Cave during the Hueco occupations was the preparation of foods, both plant and animal. It also would appear that many of the tools used for butchering, as well as for other activities, were made by the local inhabitants from the nearby rhyolite outcrops. The evidence of toolmaking within the cave, mainly on floor E1, consisted of 102 flakes, 65 chips, and a core; in zone πJ were almost 2,000 flakes and more than 1,000 chips, seven cores, a battered spherical hammer, and a pebble hammer.

In addition to these main activities of the Hueco visits to the cave was preparation of the skins of killed and butchered animals. A couple of flakes showed evidence of cutting and slicing something soft, like skins, and large convex unifaces showed similar use-wear and evidence of scraping something soft. Downslope, the evidence for scraping something soft is slim–a single domed scraper plane–but abundant evidence of slicing or shaving something soft, like skin, appears on various laterally worked unifaces–six blades, eight large convexes, three small convexes, five large concaves, a small concave, and a large pointed uniface. A single denticulate could have been used both to cut and shave hides, and sinew stones to make thongs from strips of the hides.

While other activities undoubtedly occurred during the Hueco forays, the only one of which we have much evidence was of a ceremonial nature. Downslope was a single paint palette with red ochre adhering to it; this palette could have been used in ceremonies or to paint ceremonial peoples and/or objects. As already mentioned, one pointed flake had been used for drilling something hard, such as bone, and two flakes were used to saw something hard–perhaps they were used to saw or drill bone to make beads. Evidence of beadmaking is well documented by 257 notched bone beads that probably made up a sash, about 2 feet long and 6 inches wide, that was over the shoulder of burial 4.

Burial 4 was right at the junction of zones E and πJ, just north of the dripline; charcoal and the flat slabs that topped the burial pit seem to have come from the floor, zone E1. The burial pit was oval, about 40 cm north-south and 20 cm east-west and dug about 20 cm deep. In it had been placed an adolescent male (?) in a flexed position with its head to the south and facing east. On its shoulder had been placed the sash of notched bone beads. Then the pit was filled; the four slabs–about a foot to 60 cm in diameter and 10 cm thick–were placed on top of it. Undoubtedly this burial was accompanied by major rites and ceremonies, and the ornate sash the boy was wearing hinted he was a person of some social importance.

This burial ceremony was not the only one of the zone E1 occupation, for under it was burial 6–an even younger adolescent, perhaps female–in a similar pit and in a similar flexed position. This burial was without grave goods and had but two slabs on top of it, and we guess it was dug down from the bottom of zone E and/or πJ. The proximity of the burials suggests the people involved in the later burial 4 ceremony knew of the interment of burial 6. The radiocarbon dates, however, show them to be more than 200 years apart–burial 4 at about 600 B.C. and burial 6 at 850 B.C.–implying the people involved in the ceremonies had a tradition concerning burials and perhaps a complex religious institution. This hypothesis certainly needs further testing.

The Way of Life of Zone D2

Zone D2 was composed of brown to gray soils, often powdery, with flecks of charcoal and vegetal material. Often it was lensed and relatively thick, suggesting a series of brief occupations rather than a single period of deposition. Sherd types also suggest it blended into the relatively thick lower portion of zone F down the slope. This composition suggests a series of brief occupations over a relatively long period. The San Francisco Red sherds, Three Circle Red-on-white, and Mogollon red-on-brown suggest it was occupied during Mesilla phase times, while the Mimbres type 1 and El Paso bichrome and incised sherds may indicate occupation occurred in the latter half of that phase–roughly from A.D. 400 to 900–but it could have started earlier.

The relatively small floor area covered by this zone, roughly 9 m^2, may indicate that all the brief forays into the shelter were by small groups, microbands or task forces; a single burned area in S3W4 that could have been a hearth tends to confirm this hypothesis (see Figure V-4).

The presence of bird bones and grass seeds and lack of snake, fish, or turtle bones or grinding stones suggest the occupations probably were in the spring or end of the dry season, when animals were forced to use the nearby spring and were easily killed by the occupants of the cave using bows and arrows or atlatl darts.

We have good evidence of this subsistence activity: in addition to bones of deer, we have four projectile (arrow) points–Steiner, Toyah, Cameron, and Fresno–as well as two arrow and two atlatl tips that were associated. Further, the tips, as well as a fracture on the tip of the Steiner point, suggest these points had been broken by impaction, probably the result of striking a bone in an animal (deer) when they were shot into it.

Even more numerous than the bones of big (possibly hunted) animals were those of small mammals–jackrabbits, cottontails, rodents, and birds–and these may have been collected or trapped by the shelter occupants during their brief forays. Collected materials included a number of plant remains, mainly grass seeds, opuntia leaves, agave or lechuguilla leaves, and quids, perhaps of lechuguilla. A single possible corncob fragment occurred, so the occupants knew domesticated plants, even though they were not true agriculturists.

This general picture of subsistence and sustenance–mainly collecting plants and hunting animals with little or no agriculture–is confirmed further by the analysis of a single human tooth from the deposits, for it showed a C13/12 ratio of about -14 and a N15/14 ratio of about +8. These figures seem to indicate their diet was mainly from C3 plants with limited amounts of sustenance from animals and little or none from C4 plants such as corn, results that are in full agreement with the ratio in the two Mesilla phase skeletons from nearby Mesilla Dam. Thus, while the Mesilla phase people may have often lived in pithouse villages, their relatively sedentary existence was not due to agriculture, but to successful collecting, such as we have in this occupation of zone D2 in Todsen Cave.

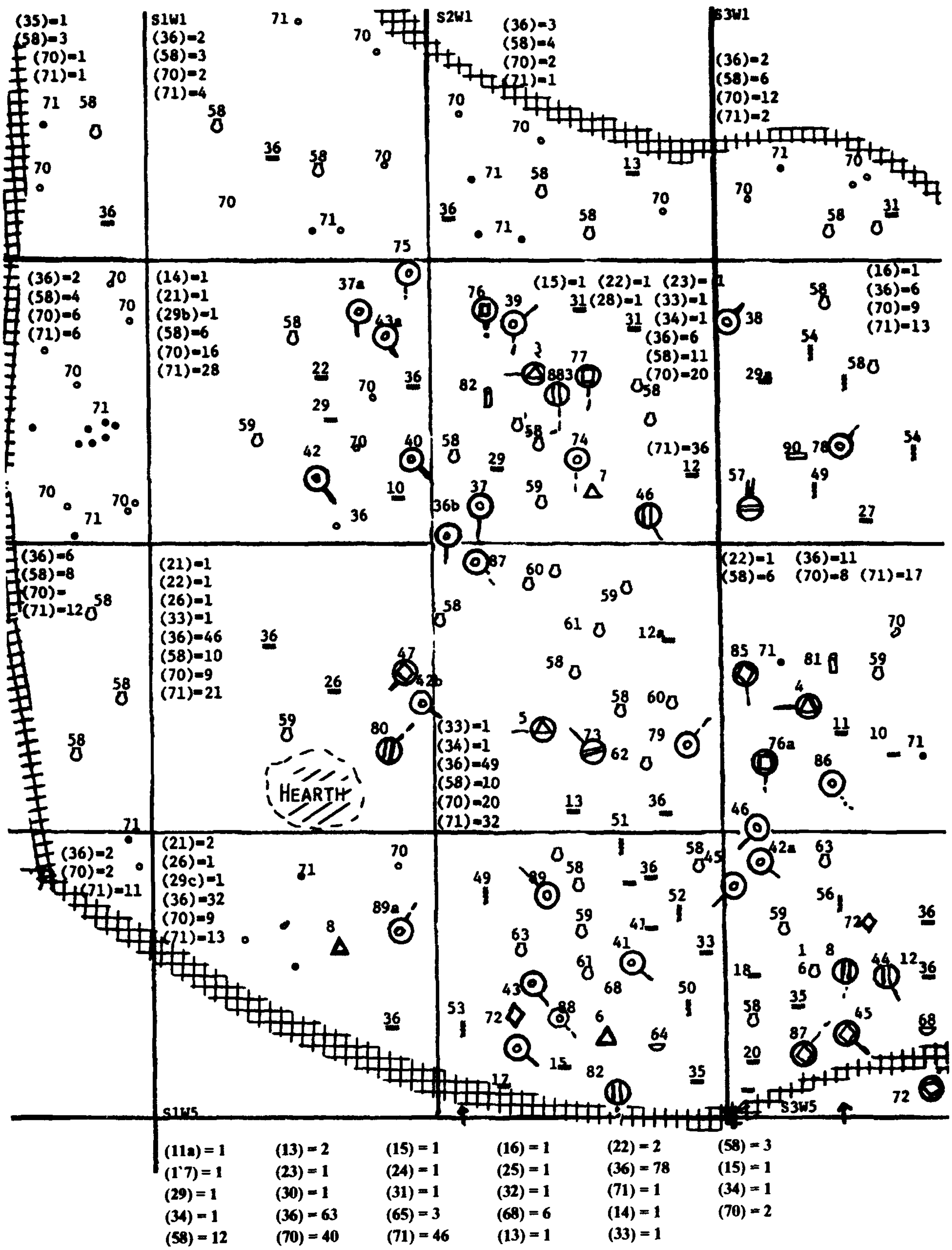


Figure V-4. Todsen Cave: Floor Plot of Zone D2, Mesilla Phase

LA5631
Zone D2
Phase: Mesilla
Estimated Dates: A.D. 400 to 900

Seasonality: Spring-Summer Wet Season – Bird Bones (1), Grass Seeds (2)
Settlement Pattern: 1 Hearth or Burned Area – Microband(s) and or Task Force Group(s)

Activity *	Type of Use-Wear	
Hunting		
Steiner (3) and 2 Point Tips (4, 5)	Impacting	Hard
Fresnal (6), Toyah (7), Cameron (8), Arrow Projectile Points		
Deer Antler (9), Maxilla (10), Metacarpal (11), Skull Fragment (11a)		
Pronghorn Antelope Maxilla (12), Calcaneum (12a), Vertebrae (12c)		
Animal Collecting and/or Trapping		
10 Jackrabbit Maxilla (13), Scapula (14), 3 Mandible (15), 2 Ulna (16), Humerus (17), Metacarpal (18), Tibia (19), Calcaneum (20), Rodent Maxilla (21), Mandible (22), Skull (23), Scapula (24), Humerus (25), Ulna (26), Metacarpal (27), Innominate (28), Femur (29), Calcaneum (29a), Carpal (29b), Patella (29c)		
3 Cottontail Rabbit Humerus (30), Femur (31), Calcaneum (32), Mandible (32a)		
8 Mouse Skulls (33), Femur (34)		
4 Prairie Dog Maxilla (35)		
Butchering		
321 Bone Fragments (36)		
3 Flakes (37, 37a, 37b)	Scraping	Hard
1 Flake (38)	Cutting	Hard
1 Flake (39)	Cutting/Scraping	Hard/Soft
6 Flakes (40, 41, 42, 42a, 42b, 42c)	Slicing	Hard
2 Flakes (43, 43a)	Shaving	Hard
1 Blade (44), 1 Half-moon Biface (45), 1 Small Convex Uniface (46)	Slicing/Shaving	Hard
1 Pebble Chopper (47), 1 Flake (47a)	Chopping	Hard
Plant Collecting and Plant Food Preparation		
Quid (49), Agave Leaf (50), Opuntia Leaf (51), Corn Cob (52), Yucca Leaf (53), Grass Seed (2)		
Boulder Anvil-Mortar-Milling Stone (57)	Back-and-Forth Grinding	Hard
Textileworking		
Yucca Yarn (54), Yucca Strand Square Knot (55), Yucca Yarn Square Knot (56)		
Storage and/or Cooking		
105 Jar Fragments of Brownware (58), 5 Jars of San Francisco Red (59), 3 Jars of 3-Circle Red/White (60)		
3 Fragments of Corrugated Jars (61), 1 Mimbres B/W (62), and 2 El Paso Black Jars (63)		
Bowls – 1 Mogollon White (64), 3 El Paso Black (65), 8 Brownware (68)		
Flintknapping		
126 Flakes (70)		
264 Chips (71)		
2 Cores (72)		
1 Pebble Hammerstone (73)		
Hide and/or Skinworking		
2 Flakes (74, 75), 1 Small Flake End Scraper (76), 1 Gouge (77)	Scraping	Medium
2 Flakes (78, 79), 1 Small Convex Uniface (80), 1 Half-moon Biface (80a)	Cutting	Medium
2 Blades (83, 83a), 1 Large Concave Uniface (84), Half-moon Biface (85)	Scraping	Soft
3 Flakes (86, 87, 88)	Slicing	Soft
1 Drill (89), 1 Flake (89a)	Cutting	Soft
Possible Ceremonial Activities		
Slab Paint Palette (80)		
Tubular (81) and Cardium (82) Beads		

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-4. continued

As might be expected, one of the main activities of the floor D2 occupants was the preparation of collected wild produce. A major activity was the butchering of the animals they killed and brought back to the shelter. In addition to the animal bones, we have 15 flakes showing evidence of at least six kinds of use-wear–six showed evidence of slicing something hard, like bone; three, of scraping something hard; two, of shaving something hard; two large flakes, of

chopping something hard or something soft (like meat); one, of cutting something hard; and one, of cutting something soft. Also, a blade and a half-moon side blade showed evidence of shaving a hard object, while a pebble chopper had chopped something hard. The refuse downslope in lower zone F+, sherds of which showed to be roughly equivalent to zone D2, had even more evidence of butchering. Not only were there bones of many animals, but they were associated with a host of tools with evidence of use-wear. Five kinds of bifaces–one pebble chopper, five large ovoid disks, one flake chopper, three pebble cleavers, and one small bifacial disk–all show evidence of chopping or battering something hard, like bone. A number of kinds of laterally worked unifaces–four small ones with convex edges, three large of the same shape, and a large uniface with a concave edge–also show evidence of use-wear that may represent butchering, mostly slicing something hard (like bone). A crude blade and one with a denticulated edge both showed evidence of cutting something hard. Seven flakes had similar signs of use–three, for cutting something hard; two, for slicing something hard; and two, for chopping something hard. Five other flakes–four large and a flake scraper plane–were used to scrape something hard.

Other tools were involved with preparing or grinding plant foods. Only one of these, an anvil-mortar, occurred inside the cave; all the others were found downslope, outside the overhang. These tools included another mortar, a pebble and discoidal muller, an elongate pebble wedge, and a small rectangular mano. The other tool found down the slope was a trough metate and, while the other plant-preparing tools probably were used on wild seeds, this may have been used to grind hard corn kernels. In the downslope refuse of zone F+, equivalent to D2, a number of tools and 13 flakes looked as if they had been used on plant and fibrous materials. Ten of these flakes were used for slicing and three for scraping something soft or fibrous. The other tools mainly are laterally worked unifaces and three blades used for slicing something soft, while one had shaved something soft and two had cut something soft. Large flakes with convex worked edges included two with evidence of slicing something soft; one, of shaving something soft, and another of scraping something fibrous. Of the small convex flakes two were used in slicing soft things, one in shaving soft things, and a small flake end scraper seems to have been used to shave something soft and/or fibrous.

As far as evidence of the actual cooking of this produce went, we found only one burned area inside the cave mouth that could have been a hearth, but many of the sherds show interior incrustations that may be evidence of cooking (boiling). The dominant ware was Jornada Brown–27 sherds from 6 bowls and 32 sherds from 15 jars or ollas inside the cave, while downslope were 57 sherds of about 30 ollas and two more bowl fragments. In addition we found nine fragments of nine San Francisco Red ollas in the cave, as well as one sherd each downslope of an olla and bowl of this type. Also present in the shelter were two bowl fragments of Mogollon Red-on-brown, as well as a single bowl of Mimbres type 1, a bowl sherd of Three Circles Red-on-white, a Mogollon incised olla sherd, and one El Paso Bichrome olla sherd. Downslope were a corrugated sherd and another Jornada or El Paso Bichrome sherd.

It would seem a great many of the tools actually were made at the rockshelter during this Mesilla phase occupation. In other words, flintknapping was a major activity, as indicated by abundant tools both in the shelter and downslope. In zone D2, 320 chips, 159 flakes, 3 cores, a pebble hammer, and an anvil occurred, while in the F+ equivalent downslope were 601 chips, 317 flakes, 4 cores, a pebble hammer, and a piece of antler that seems to have been used as a retouch flaker.

Evidence of other industries or activities is scantier, although a number of tools seem to have been involved in hideworking; two flakes, a small flake end scraper, and a gouge show evidence of scraping something of medium softness, such as hides. Also, two flakes, a small convex uniface, and a half-moon side blade show evidence of cutting hides, while two blades, a large convex side scraper, and a half-moon side blade show evidence of scraping hides or something equally soft. All of these tools were found within the shelter. Downslope, three flakes that showed evidence of scraping hides were associated with a sinew stone and bone rasp. Akin to these tools are three flakes in the D2 refuse that seem to have been used to slice wood and one flake used for drilling either wood or hides.

Objects of an artistic or ceremonial nature include paint palettes, polished bone, a tubular bone bead, a cadium shell bead, a disk bead, as well as denticulates that could have sawed such beads, although the lack of shell debris suggests the beads were made elsewhere. Some of the polished bone could have been used in weaving, but such manufacturing may not have been done in the cave.

Our analysis of the artifacts and ecofacts of zone D2 and the equivalent downslope refuse give us a glimpse of the way of life of Mesilla peoples in the period roughly from A.D. 250 to 900, which should supplement data we have of pithouse hamlets or villages.

The Way of Life of Zone D1

Even more difficult to interpret is the way of life of zone D1, for it had fewer artifacts and ecofacts and was a thin strata never more than 5 cm thick that covered a small area–6 or 7 m^2. It varied in color from light brown to pale yellowish and was extremely compact clay. The upper surface was smooth and often bore scars or fiber marks, indicating it had been smoothed when wet and allowed to dry hard, and contrasted with the under part that was irregular and full of vegetal materials that blended into the underlying zone D2. Our interpretation of the layer was that the shelter's occupants purposely had plastered a layer of wet clay on top of zone D2 and then smoothed the wet surface with handfuls of wet grass to make a hard living surface. The snake vertebrae, grass seeds, and agave and opuntia leaves found there suggest this was done in the spring and/or early summer wet season, probably the latter. The limited number of bones and small area suggest it was occupied by a microband and/or task force for a few days or weeks.

Sherds included an El Paso Polychrome and two San Francisco Red, suggesting the occupation occurred early in the El Paso or Doña Ana phase, perhaps between A.D. 950 and 1100.

The arrow and atlatl tip found in association with deer teeth and split large mammal bones suggest the people hunted during their brief stay, while bird, rodent, and jackrabbit bones indicate hunting and/or trapping for food. The seeds (grass), agave leaves, fibrous quid, and opuntia leaves indicate plant collecting.

The fragments of various vessels included nine different jars of Jornada Brown, as well as a corrugated one, an incised one, an El Paso Polychrome jar, and an olla of San Francisco Red. Some of these sherds have food residue on them, which indicates that during the sojourns the people cooked their food and perhaps ate it out of bowls of Jornada Brown, San Francisco Red, or Three Circle Red. Other jars may have been used to carry water and/or to store food.

As evidence of butchering some of the game we have two blades and a large uniface with its convex edge showing signs of slicing something hard, like bone, while a side blade shows evidence of cutting something soft, like meat or hide. Three flakes had evidence of scraping and slicing and/or shaving bone and/or hard wood. Associated with them was a pointed flake with evidence of woodworking. While all the above tools could have been used in butchering, their association with many wood fragments, wood chips, cut wood, and sliced wood suggests the inhabitants were involved in woodworking that was something more than cutting firewood for the hearth called feature 9.

As might be expected, some of the tools for both butchering and/or woodworking seem to have been made on the spot: we found more than 49 chips and flakes and a nebulous core in association with a deer antler flaker. Downslope from the D1 floor, in zone F+, was even more evidence of flintknapping, butchering, food preparation, and woodworking. Here also was found a piece of shell bracelet, while on the floor itself was a piece of Z-twisted hard fiber (agave?) yarn that could have been part of the wearing apparel of the visitors to the cave in D1 times.

Our analysis of zone D1 gives us a glimpse of the way of life of the El Paso and/or Doña Ana phase people that is rather different from that gained from analyses of their village life in the nearby pueblos.

The Way of Life of Zone D

Zone D, while thicker than zone D1 (10-20 cm), was often disturbed by pits (often made by looters) extending down from the surface or from zones A and B of Historic times as well as zone C. Generally speaking, zone D was a dark brown in color, but varied considerably from ashy dark gray to light orangish brown and usually had flecks of charcoal or vegetal remains in it. Generally, it was not very compact and had lenses of different texture, ranging from layers of preserved vegetal materials to lenses of ash or silty-powdery soils towards the front of the cave. Here, along the east-west O-axis, where it faded into the top levels of zone F+, zone D had a tendency to be thicker and have more superimposed lenses. We attempted to strip these off in levels, but were not very successful, for the lenses covered only small areas and were very thin and faded out. Certainly from a stratigraphic or occupational point of view, zone D does not look like a single occupation, but a whole series of visits to the spring during the springtime, by people of the early El Paso phase (A.D. 1100-1200).

This hypothesis of multiple occupation seems to be confirmed by the area included in zone D, for it covers a large area of more than 20 m^2 inside the cave (see Figure V-5), and much of the refuse down the slope in the upper levels of zone F+ covers an even larger area (30 m^2). In terms of distribution of artifacts, two definite concentrations occur–area 1 to the east, which includes Beckett's Trench, is the larger one, covering about 11 or 12 m^2 and containing

two hearth areas. Area 2, on the west part of the shelter floor, covered only about 6 or 7 m^2 and had but a single hearth. Even if both areas were occupied at the same time, the group would have been small–perhaps at most 2 or 3 families composing a microband–but the lensing and distribution of the fireplaces and the fact that the sherds of each area (and even of each 1 m^2) seem to be single vessels that do not fit together or have the same parts suggest many visits by many small groups of task force or family size. The lack of storage pits also speaks for brief forays into the cave rather than prolonged visits.

The ceramic analysis by David Hill suggests all these small groups had an El Paso phase type of culture and the visits therefore were made roughly from A.D. 1050-1150. His analysis of the sherds from the talus slope in zone F+ indicates even more variability in the artifacts and ceramic assemblage, as well as the fact that four burials–burials 2, 3, 5, and 7, all of Puebloan physical type–pertain to the occupations of zone D.

Activity area 1 in the east part of the shelter showed the greatest variability. The floor or zone plot shows it was loaded with artifacts and ecofacts, particularly in squares S4W1, S3W1, S1W1, and S1E1. Although we lack firm data about materials from Beckett's Trench, it seems to have had abundant sherds in three more squares–051, 052, and 053.

Before discussing the activities in this eastern part of zone D, however, let us say something about the seasonality of these occupations. The few vegetal remains–seven corncobs, a cucurbita seed, and a gourd peduncle, as well as bundles of cotton–suggest some of the occupations occurred during the wet season, but grass seeds indicate some of them may have started in the spring. The relative lack of bird bone and mesquite pods, as well as fish and turtle bones, however, seems to show this activity area, unlike number 2 of zone D, was not predominantly a late winter-spring occupation, when Todsen Cave, next to the spring, becomes a desirable place for thirsty animals to visit. The limited seasonality data suggest areas 1 and 2 of zone D were not used contemporaneously, and the occupations of both were by extremely small groups of transients. Further, the relative lack of bones of large animals that would feed large groups or any group for long periods, suggests the occupations were not only by small groups, but were very brief–at most a few weeks or even a few days.

Now the question becomes: On what did these small El Paso phase groups subsist during their brief forays into the shelter? We have evidence of a number of subsistence activities. One of these is hunting with a bow and arrow, as evidenced by a Fresno point tip, a Cameron point with its tip fractured by impacting, and a cane arrow shaft in association with a deer tooth, phalange, and eight long bones. The smaller mammal bones–a cottontail femur and ulna, a mouse scapula, and bones of various rodents–also are evidence of eating meat, probably acquired from collecting and/or trapping rather than hunting.

Almost as numerous as the evidence for meat collecting is that for plant collecting: a couple of fragments of opuntia leaves, an opuntia stalk, three lechuguilla and/or agave leaves, three grass seeds, a cactus and a mesquite spine. Further, one flake shows evidence of having been used to cut vegetal materials, and a large convex unifacial, laterally worked, has signs of scraping something soft, like plants.

These tools could have been used in collecting or preparing either agricultural or wild plants. From skeletons of this period (to be discussed later), as well as the garbage in zone D, we do have evidence these El Paso people consumed agricultural food. The garbage included five Puebloan corncobs, with kernels shaved off, a Pima-Papago cob, and a Maiz de Ocho cob, as well as a pumpkin seed *(Cucurbita pepo),* and a gourd stem.

The El Paso people performed such subsistence tasks from their base in the cave. What they mainly did in the cave was prepare the results of their subsistence activities (that is, the food) so they could consume it, probably in the cave itself.

Since hunting and small mammal collecting were major activities, the bones of the previously mentioned animals, as well as 94 unidentifiable fragments–most of which had been split (for marrow?)–are evidence that the cave inhabitants did butchering in area 1. Even better evidence are the 29 or more tools showing use-wear from working on hard or soft bone. In fact, the split bones just mentioned could well have been cracked by the pebble chopper, and a large flake has evidence of bifacial battering of the sort that could have come from hammering bone. Other tools included a crude blade with edge evidence of cutting and chopping something hard, like bone; a large uniface, the lateral convex edge of which showed signs of slicing and scraping bones; a uniface with a denticulated lateral edge that was used to shave bone (perhaps to get the meat off); two small unifaces (the convex lateral edge of one showing evidence of slicing, the other showing evidence of both slicing and scraping); two long pointed unifaces, the edges of which show evi-

dence of slicing bone; eight flakes showing evidence of shaving bone; two flakes with traces of cutting and slicing bone respectively; and ten other flakes with evidence of scraping bone, probably to remove the adhering meat. These tools thus indicate butchering was a major activity of the occupations in area 1.

Of equal importance was cooking the prepared food, as well as other food, in clay vessels (at least 17)–indicated by burned residue on the walls of three Jornada Brown ollas or jars, two corrugated jar walls, and the inside of a Mimbres type two, Black-on-white jar. Analyses of residue show both plants and animals were cooked (boiled?). While many vessel sherds had no direct evidence of cooking, such could have happened without the cook burning or spilling the food. On the other hand, these jars, as well as others, could have been used for drawing water or for storage, while the two bowls of Jornada bichromee could have been used for eating. The other vessels without residue included four Jornada Brown jars, two Mimbres type three jars, a jar of corrugated ware, and an El Paso Polychrome jar. The preparing of food and drink thus was a major activity during the El Paso phase visits.

These same 32 sherds, which come from at least 17 vessels, hint at another cultural phenomenon noted in Hill's analyses–that is, almost every one of the 17 is made of different pastes and of clays unlike any found near the shelter, suggesting the sherds came from a wide variety of sources. Whether this variety came from trade or was the result of the shelter's inhabitants being from many different locations is difficult to discern. No matter which is true, the fact remains that the occupants of zone D, area 1, had widespread cultural relationships.

Before we end this section, it might be added that the presence of a single bifacial slab metate suggests some of the corn was being ground in the cave. However, although grinding corn was a major female activity in the El Paso phase pueblos, to which these people belonged, the activity was not important here.

Evidence of another activity that could represent preparation of plants for food is equivocal, for the wear resulting from cutting wood is extremely similar to that from working on plants. We did find more than 56 fragments of wood, some of which could have been cut to make fires for heating food in pots. Also, four tools showed wear from working on vegetal materials. One was a small uniface, the lateral convex edge of which showed evidence of sawing vegetal material; another was a blade with edge wear resulting from slicing wood, while the other two were flakes, one of which showed evidence of shaving wood, and the other of scraping wood. Although lacking signs of use-wear, a blade and biface half-moon blade still could have been used on some soft vegetal material.

Many of the other tools, mainly of rhyolite or flint, seemed to have been manufactured by flintknapping; ample evidence exists of this activity–some 277 chips and 64 flakes with striking platforms in association with five cores and a nebulous core that showed evidence of being used as a hammer. Also, two pieces of deer antler could have been used as pressure flakers. Certainly this debitage suggests the occupants made the tools they needed for butchering and hunting during their brief sojourns, perhaps using the nearby rhyolite sources in the hills a mile or so south of the site or on Picacho Peak, 3 miles away.

Objects in area 1 hinting that the occupants were connected with less mundane activities include a tiny flat bottle-shaped shell bead and three fragments of three different notched shell bracelets made from olivella shell from the Pacific Ocean. Three flakes and a blade with evidence of sawing something hard, such as bone or shell, might have been the tools of the shellmaking trade, but lack of shell fragments or debitage hints these ceremonial or decorative objects were made elsewhere, and the tools probably were connected with butchering. Another object that may be of a decorative or ceremonial nature was a fragment of a sandstone disk with some sort of radial design, painted red, on it. We dug up three fragments of paint palettes in the area that might be connected, but again the lack of ground stone debitage hints that these palettes were manufactured elsewhere. Perhaps the disk was just part of the people's wearing apparel that got dropped in the shelter, along with the few textile fragments–a small fragment of cloth made with yarn twisted by a spindle whorl and woven on a one-over-one belt loom and a bundle of cotton fibers. Although these remains suggest a textile industry, it seems likely such fabrics were made elsewhere. However, two other objects indicating a textile industry–a single Z-twist yarn made of hard (agave?) fibers and similar yarn with a square knot–could well have been made in the cave, although the lack of agave quids suggests even this manufacturing occurred elsewhere.

All in all, the artifacts and ecofacts of area 1 were not numerous or impressive, nor can they be said to be representative of the whole cultural complex or time period of occupations by El Paso phase peoples. Yet area 1 gives us a glimpse of the way of life El Paso people followed while making brief visits to a cave away from home or during their travels going from one pueblo to the next.

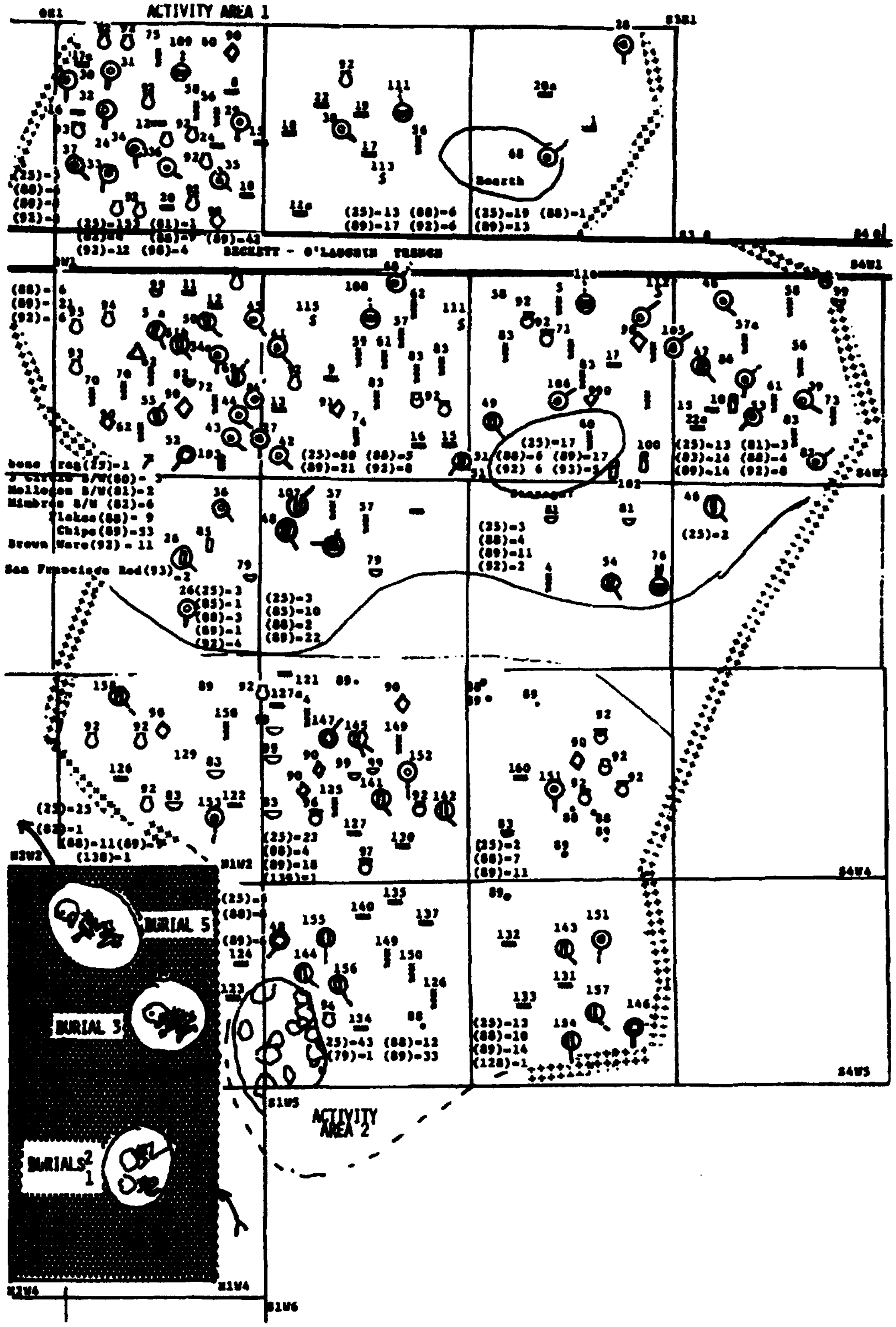


Figure V-5. Todsen Cave: Floor Plot of Zone D, El Paso Phase

LA5531
Zone D
Phase: El Paso
Date: 1050 to 1150

Activity Area 1
Seasonality: Mainly Summer – Corncobs (1), Cucurbit Seed (2), Gourd (3), Grass Seed (4), Cotton (5)
Settlement Pattern: Microbands and/or Task Force Groups – 2 Hearths

Activity *	Type of Use-Wear	Medium
Hunting		
Cameron Points (6)	Impacting	Hard
Presno Point (7), Cane Arrow Shaft (8)		
Deer Antler (9), 2 Phalanx (10), Tooth (11), Skull (11a)		
Animal Collecting and/or Trapping		
Rodent 2 Mandibles (12), Tooth (13), Scapula (14), 2 Humerus (15), Metacarpal (16), Femur (17), 3 Skulls (17a); Cottontail Ulna (18), Femur (19), Mandible (20), Humerus (20a); Mouse Mandible (21), Scapula (22), Humerus (22a); Jackrabbit Mandible (23), Maxillae (24)		
Butchering		
325 Bone Fragments (25)		
Flakes (26, 27, 28, 29, 30, 31, 32, 33, 34, 34a)	Scraping	Hard
Flakes (35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45)	Slicing	Hard
Large convex (46), 2 Small Convex (47, 48), 2 Pointed Unifaces (49, 50)	Slicing	
Blades (51, 51a, 51b)	Slicing	
Pebble Chopper (52), Large Flake (53)	Slicing & Chopping	
Denticulate (54)	Chopping	
Blade (55)	Shaving	
Plant Collecting		
Grass Seeds (4), Opuntia Leaf (56, 57), Opuntia Stalk (57a), Lechuguilla Leaf (58, 59, 60), Cactus (61), Mesquite Spine (62)		
Flake (63), Large convex (64)	Cutting	Soft
Agriculture		
Pueblo Corncobs (70, 71, 72, 73, 74), Pima-Papago Cob (75), Maiz de Ocho (31), Pumpkin (2), Gourd (3)		
Bifacial Slab Metate (76)		
Storage and/or Cooking		
Jars – 2 Brownware (92), 5 San Francisco Red (93), 1 Incised (94), 1 El Paso Black (95), 2 El Paso Poly (96), 1 El Paso Bichrome (97), 12 Corrugated (98)		
Bowls – 5 Brownware (99), 2 San Francisco Red (79), 3 B/W (80), 7 Mogollon White (81), Mimbres B/W (82)		
Wood or Plant Work		
36 Wood Fragments (83)		
Small Convex (84)	Sawing	Medium
Blade (85), Flakes (86, 87)	Slicing	Medium
Flintknapping		
64 Flakes (88), 277 Chips (89), 5 Cores (90), L Core-Hammer (91)		
Shellworking		
3 Olivella Shell (100, 101, 102), Bottle Shell Beads (103)		
3 Flakes (104, 105, 106), Blade (107)	Cutting	Hard
Ceremonial		
3 Paint Palettes (108, 109, 110)		
1 Sun Disk (111)		
Textileworking		
Square Knot (112), Cotton Yarn (113), Textile (114), Agave Yarn (115)		

Activity Area 2
Seasonality: Spring – Grass Seed (4), Crane (122), Fish (123), Turtle (124), Mesquite (125), Sotol (126), Snake (127)
Settlement: Microband(s) or Task Force Group(s) – 1 Hearth

Activity

Hunting and Butchering
Deer Antler (127), Jaw (128), Tooth (129), Antelope Femur (130)

*Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-5. continued

Activity *	Type of Use-Wear	Medium
Animal Collecting and/or Trapping		
Rodent Humerus (131), Cottontail Mandible (132), Ulna (133), Prairie Dog Mandible (134), Mouse Atlas (135), Rib (136), Vertebrae (137), 10 Jackrabbit Ulna (138), Patella (139), Vertebrae (140)		
Butchering		
102 Bone Fragments (25)		
Blade (141, 142), Convex (144)	Slicing	Hard
Large Concave (145)	Slicing/Shaving	Hard
Gouge (146)	Shaving	Hard
6 Bifacial Knives (147)	Cutting	Hard
Disk (148)	Chopping	Hard
Plant Collecting and/or Woodworking		
Wood (149), Fiber (150)		
3 Flakes (151, 152, 153), Backblunted (154), Pointed Flake (155)	Scraping	Medium
Small Convex (156), Small Concave (157), Large Concave (158)	Shaving	
Storage and Cooking		
Jars – 7 Jornada Brown (92), 1 Mogollon Incised (94), El Paso Brown (97), El Paso Poly (96)		
Bowls – 1 San Francisco (79), 4 Jornada Brown (99), 3 Mimbres B/W (83)		
Flintknapping		
47 Flakes (88), 91 Chips (89), 3 Cores (90), Core Hammer (91), Pebble Hammer (159), Flake (160)		

Activity Area 3

Burials 2-3 – Flexed Children – No Grave Goods
Burial 5 – Flexed Child – No Grave Goods
Burial 7 – Flexed Child – No Grave Goods

*Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-5. continued

While the soil and content of area 2 of zone D are much like those of area 1, the area was much smaller–only 6 m^2–and had but a single rock-filled hearth in it. Thus, its population was small, not more than a single family, microband, or task force group, and the occupation time was brief. Crane bones in the area suggest a spring occupation, but the turtle and snake vertebrae and sotol seeds could be either spring or summer. We would guess the stays probably were mainly spring occupations that might have lasted into the summer. If so, then there is a chance, albeit a slim one, that both areas could have been occupied contemporaneously; even so, the population could have been, at most, only about three or four families (12 people).

The evidence for subsistence activities in area 2 is even poorer than in area 1; we found no arrow or atlatl points or evidence of receptacles used for collecting. However, the presence of deer and antelope bone do suggest hunting, while the small mammal and plant remains suggest collecting. No evidence exists of agriculture or the preparation of agricultural food, further suggesting this occupation occurred during the dry spring season, when crops normally cannot be grown.

Although we have little evidence of subsistence activities, we do have abundant evidence of the proportion of the products that came from such endeavors. Our best documented evidence is for butchering of the game brought back to the shelter. In addition to 96 split fragments of small animals, we found teeth, a scapula, a humerus, a radius, metapoidal, tibia, and ribs of various small unidentified animals, as well as a rodent mandible, tooth, and humerus; cottontail rabbit mandible and ulna; mouse skull, metapoidal, rib, and vertebrae; and a jackrabbit ulna and patella. Large animal bones were less numerous and included six large split fragments of long bone, a deer antler, a deer jaw and tooth, and a long bone of a pronghorn antelope. Associated with them were a number of tools with evidence of wear against bone, perhaps caused by slicing the bone to remove the meat. These tools included two crude blades with evidence of slicing; a large convex side scraper with evidence of slicing and shaving; two concave side scrapers with evidence of slicing wet and dry bone; a gouge; a flake with evidence of scraping something hard, like bone; a bifacial knife with signs of cutting (meat); and a small bifacial disk with evidence of chopping. The inhabitants of area 2 thus were heavily involved in butchering and preparing meat for consumption.

Some of this meat could have been roasted on the hearth on top of its fire-cracked rocks, while other portions of meat could have been cooked in the ceramic vessels, of which we uncovered many fragments. One olla sherd had

food residue in its interior, as did two Jornada Brown jars. The other vessels–one San Francisco Red bowl, four Jornada Brown bowls, three Jornada bichrome bowls, four Jornada Brown jars, a Mogollon incised jar, a Mimbres type three jar, and an El Paso Polychrome (found down the talus slope)–could have been used for cooking, and/or for drawing water.

In addition to signs of food preparation in area 2 of zone D, we found evidence of flintknapping–91 chips, 47 flakes, and parts of three cores in association with a pebble hammerstone, a core with evidence of pecking, and a piece of antler that could have been a flaker.

People in this area also seem to have been involved in working vegetal materials–either wood or leaf fibers or opuntia leaves. Three flakes show evidence of scraping wood; a small convex side scraper, a large concave side scraper, and a small one all showed evidence of shaving wood and/or fibers, while a back-blunted knife and a pointed uniface showed use-wear from scraping wood. Exactly what the people were making of wood or fiber cannot be determined, but some of the worked wood could have been used for cooking fires.

The few visitors to area 2 of zone D mostly did mundane things during their short stays. A study of the talus materials, where the sherds suggest some of the top levels of zone F+ were of zone D times, indicates some burials in area 3 could pertain to the occupations of zone D. All the burials were of children in fetal positions and without grave goods. Analysis of the C13/12 in the collagen of their bones ranged from -8 to -9.5; N15/14 isotope ratios ranged from +7 to +8, indicating all ate a diet based predominantly on corn grown by agriculture; the high nitrogen figures suggest aquatic (Rio Grande) products were more important than land animals. Other ecofacts and artifacts of the talus indicate other possible activities of the general zone D time period.

These data from zone D provide new insights into the culture of the El Paso phase between A. D. 1050 and 1150 in the Las Cruces region.

The Way of Life of Zone C

This stratum of Todsen Cave is composed of sandy clay, yellowish brown in color, fairly compact, and never more than 5 cm thick. It may be an alluvial deposit or eolian clayish silts that were cemented by water and lived on. Zone C covers only a small section in the back of the shelter; outside the dripline, it fades into the darker brown of zone F+, which may well represent refuse that flowed or was poured out of the real occupational zone.

Zone C probably was deposited in a relatively brief time span; two obsidian hydration dates suggest this period was from before A.D. 1625 to just after A.D. 1675 (see Figure V-6). That it was roughly of that time period is confirmed by the finding of hand-hammered nails, painted glass, the rim of an iron kettle, Spanish-Mexican glazed sherds, and a few possible Apache or Piro sherds. Further, the single child skeleton from the upper part of zone F+ of the talus has an undeformed and low (Mongoloid) skull, which is much like those of the Apache of Historic times.

Whatever the occupation or occupations, the bones, the limited extent of the zone, the single hearth, and the thinness of the stratum suggest the group or groups were small and the occupation or occupations brief. In fact, the study of the bones suggests the presence of not more than three deer, a couple of rabbits, and a few other small animals, equaling only about 180 pounds of meat. Since many primitive people ate more than 2 pounds of meat a day, a single individual could have subsisted for only 90 days, while five people could have lasted fewer than 18 days. The three possible activity areas suggest the occupation might have been larger in size–a macroband or family group–but it still is possible the three activity areas were occupied by three small task force groups. The bones of fish and crane suggest all occupations occurred during the spring season. If there were three occupations, they probably were contemporaneous or even a macroband occupation–but the evidence hardly is conclusive.

What did this group or groups do at the rock shelter? Let us consider each of the three activity areas separately.

Area 1, in the northeast corner of the cave floor inside the dripline, seems confined to two 1-m squares, S2E1 and S3E1, but probably extended in the east part of Beckett's Trench in the adjacent squares, S1-0 and S2-0. At most, it covered 4 m^2 and probably considerably less. An analysis of the artifacts and ecofacts suggests two main activities, the butchering of game and related food preparation. Evidence of butchering are the nine fragments of cracked large mammal bone (probably deer, as they are associated with a deer tooth, femur, and two possible ulnas), three fragments of small mammal bones, a jackrabbit long bone and a femur, rodent bones, and a dog tooth in association with two chips, one with evidence of cutting hard bone and the other of cutting or slicing something softer, such as wet bone.

Eight other rhyolite chips were found that could have been prepared for butchering by flintknapping–probably done in area 2. The bones of the various animals were the result of subsistence activities such as hunting (deer) and trapping and/or animal collecting. Although these activities occurred during this occupation, they were not done specifically in or on this activity area.

The food preparation activity resulted from and was connected with butchering. Much of the food seems to have been cooked in three jars of brownware, since foodstuff was adhering to the interiors of those jars. The fragment of iron pot and glass jar could have served a similar function. We found wood chips that could have come from a steel ax cutting wood to be used as firewood for heating the food in the vessels, and the pit could have been used to store food and the single Pueblo corncob uncovered. The iron fragment and glass indicate trade or exchange activities (with exchange including Apache pillage). All in all, the activities of area 1 were simple and mundane and could have been done by a task force person or group or could have been connected to and contemporaneous with those of area 2.

Activity area 2 was confined to parts of five squares in the middle of the shelter and probably extended into the west part of Beckett's Trench. It contained a large burned area, about 60-70 cm in diameter, that probably was a hearth area. One of the obsidian chips from this area dated at A.D. 1675 and another at A.D. 1625. Iron fragments, wood chips cut by a steel ax, and two Spanish/Mexican glazeware sherds from two different vessels indicate an Historic occupation, albeit a very small one, for perhaps a very brief period.

Beside the deer bone fragments was a Cameron projectile point from the top of Beckett's Trench, indicating hunting with a bow and arrow; as well as a T-shaped drill, the tip of which had been snapped off by percussion; and perhaps the tip of a projectile (atlatl dart) that struck something hard, like the bone in an animal it had pierced. The jackrabbit bones could have come from an animal killed by an arrow, but it might have been trapped and/or collected instead.

Ample evidence exists of butchering game, not only from the splinter fragments of the bones themselves, but also from three associated rhyolite chips with use-wear showing cutting of something hard, like bone; a chip showing wear from slicing bone; and a pebble cleaver with a battered cutting edge that could have been caused by chopping bone. Evidence of preparing the meat from deer and jackrabbit includes the fragments of two Mexican vessels, the iron kettle fragment, the steel-cut wood chips, and burned wood as well as the hearth area itself.

The only area 2 activity not found in activity area 1 was flintknapping–perhaps the making of tools for butchering and hunting–indicated by a core, 22 flakes, and 43 chips in association with a small rectangular mano that showed pecking (from percussion chipping) on one end.

Whether this foray was in the spring and was contemporaneous with areas 1 and 3 is difficult to determine, but activities in the three areas were monotonously the same.

Activity area 3 was in the westernmost four or five 1-m squares of our excavation, and a slightly larger number of artifacts and ecofacts occurred. The group represented must have been small and the duration of the spring foray brief. We say "spring foray" because of the presence of three large crane leg bones and a fish vertebra.

The association of deer bones with the base of a Washita point, the tip of which had been snapped off by percussion, suggests bow and arrow hunting was a major activity during this sojourn, but the bird and small animal bones suggest collecting and/or trapping also occurred, while the fish vertebra suggests fishing in the Rio Grande some 5 miles away.

As evidence of butchering, the deer, jackrabbit, rodent, and bird bones were associated with four flakes and a blade showing evidence of cutting or slicing soft bone (or wood). These same utilized ecofacts, however, could indicate woodworking since they were associated with many wood slices–a few of which had been cut by a steel ax.

Needless to say, some of this wood may have been cut to build a fire or fires (feature 5) to cook food such as the meat from the butchered animals. Cooking may have been done in the three ollas or bowls of crude brownware or in the jar of Jornada Brown or the jar of Historic (Apache or Manso) crude ware. However, only three sherds showed interior residue that suggests use in cooking food, so some of these vessels also could have been used for storage or for drawing water at the nearby spring. The single sherd of Mogollon Red-on-Brown we found we believe was dug up from an earlier layer.

As evidence that some of the stone tools were made on the spot, we found two cores, 22 chips, and 32 flakes associated with two river pebbles that bore percussion pecking on their ends. Once again, opportunistic flintknapping was being undertaken.

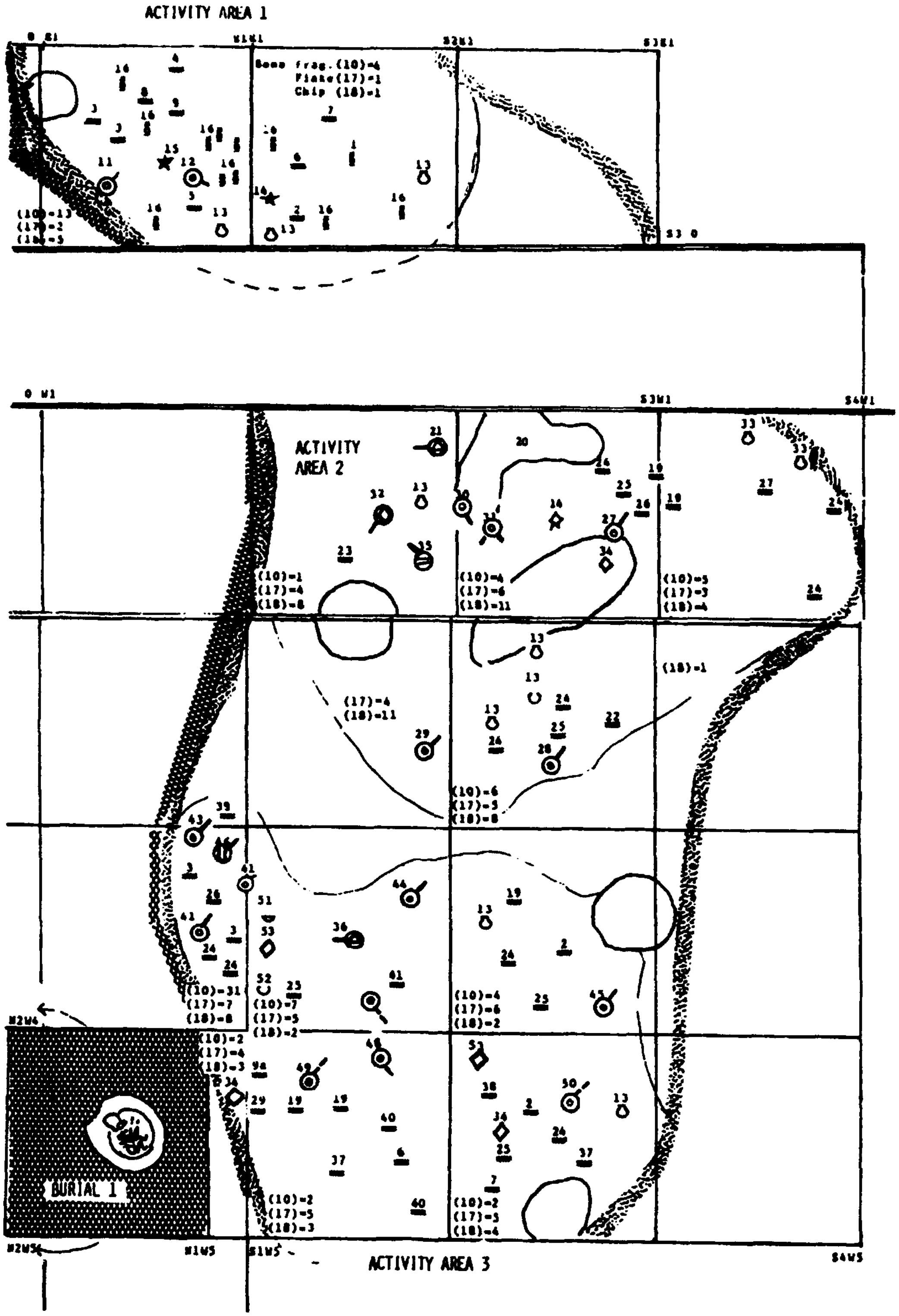


Figure V-6. Todsen Cave: Floor Plot of Zone C, Proto-Historic Phase

LA5531
Zone C
Phase: Apache (?)
Obsidian Hydration Date: A.D. 1625 to 1675

Activity Area 1
Seasonality: Wet Season – Pueblo Type Corncob (1)
Settlement Pattern: Task Force Group(s)

Activity *	Type of Use-Wear	
Hunting		
Deer Tooth (2), Femur (3), Skull Fragment (4)		
Animal Collecting and/or Trapping		
Jackrabbit Mandible (5), 2 Right Femurs (6, 7)		
Rodent Mandible (8)		
Dog Tooth (9)		
Butchering		
17 Bone Fragments (10)		
Flake (11)	Cutting	Hard
Flake (12)	Slicing	Hard
Storage and/or Cooking		
Jars – 3 Brownware (13), Fragment Iron Kettle (14), Glass (15), 11 Wood Chips (16)		
Flintknapping		
3 Flakes (17)		
6 Chips (18)		

Activity Area 2
Seasonality: Wet Season – Large Bird (Crane?) Femur (19), Fish Vertebrae (19a)
Settlement Pattern: Microband(s) and/or Task Force Group(s) (3) – Large Hearth (20), 2 Storage (?) Pits

Activity		
Hunting		
Cameron Arrow Point (21)	Impacting	Hard
2 Deer Teeth (22), Femur (23), Large Limb Bone Fragments (24)		
Animal Collecting and/or Trapping		
Rodent Mandible (25), Jackrabbit Humerus (26)		
Butchering		
16 Bone Fragments (10)		
3 Flakes (27, 28, 29)	Cutting	Hard
1 Flake (30)	Slicing	Hard
1 Flake (31), 1 Pebble Cleaver (32)	Chopping	Hard
Storage and/or Cooking		
Jar of Mexican Glazeware (33), Iron Kettle (4), Brownware (13)		
Flintknapping		
32 Flakes (17)		
22 Chips (18)		
1 Core (34)		
1 Mano (35)	Pecking	Hard
Burial 1 in insert as is downslope in Zone F – Flexed (in Sitting Position) Infant – No Grave Goods		

Activity Area 3
Seasonality: Wet Season – 3 Crane Femurs (19), Fish Vertebrae (19a)
Settlement Pattern: Microband(s) and/or Task Force Group(s) – One Burned Hearthlike Area

Activity		
Hunting		
Washita Arrow Point (36)	Impacting	Hard
2 Deer Teeth (2), Femur (3), Mandible (4), Large Long Bones (24)		
Animal Collecting and/or Trapping		
Jackrabbit Femur (7), Mandible (6), Humerus (26), Skull Fragment (41)		
Rodent Mandible (25), Femur (37), Ulna (38), Calcaneum (39), Skull Fragments (40)		
Butchering		
48 Bone Fragments (10)		
4 Flakes (42, 43, 44, 45), Crude Blade (46)	Cutting	Hard
Woodworking		
2 Flakes (47, 48)	Slicing	Medium
2 Flakes (49, 50)	Cutting	Medium
Storage and/or Cooking		
Jars – 2 of Brownware (13), 1 of Polished Brown (51)		
Bowl of historic (Apache?) Plainware		
Flintknapping		
32 Flakes (17)		
22 Chips (18)		
2 Cores (34)		
2 Pebbles (53)	Pecking	Hard

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-6. continued

Three other rhyolite flakes suggest the possibility of still another activity, for all have fine nicks on them with a round surface that matches our experiments with cutting, slicing, and scraping hides. Cutting hard, dry meat, however, gave very similar results, so it is difficult to state definitely that there was leather or hideworking and not hard meat cutting, although both activities could have been undertaken using the same flakes.

Our attempts to analyze the top layers of zone F+ down the slope suggest most of the tools that drifted or were thrown down the slope from the zone C occupations were not very different. Our plotting of the late-type sherds by a few squares and on upper levels was our only way of determining what part of the nebulous dark brown refuse of zone F+ might pertain to the zone C (Apache?) occupation. Although the results are not very secure, the tools in zone F+, which originally might have pertained to the zone C occupation, suggest flintknapping, butchering, hunting with bow and arrow, food preparation, and hideworking occurred.

Although much of the evidence for reconstructing the activities of zone C from the refuse of the cave slopes is not very convincing, one feature was of an entirely different nature. This was burial 1, in square N2W3 in levels 3-4 of zone F+. It was of a child–of 2-4 years, according to milk teeth dentition–who was buried in a sitting position, probably in some sort of small cylindrical pit, but without apparent grave goods. A study of its bones indicates some significant facts. The child seems to have been brachycephalic and very low headed, like an Apache, so we think it might be connected with the Apache-like tools of zone C. Further, analysis of C13/12 isotopic ratios in the collagen of the skeleton gave a reading of -13.1, suggesting this infant ate far more C3 leafy plants than C4 seed plants–including corn–a ratio most unlike the Pueblo diet of early zone D or the Late Pueblo of the Socorro Mission, which dates from A.D. 1684-1830. In fact, in terms of plants in its diet, the infant was more like people of the Late Archaic than those of the Historic period. Analysis of N15/14 isotopic ratios in the skeleton, however, showed a reading of +9.84, which made its diet more like those of the Socorro Mission Pueblos who ate domesticated European animals such as sheep, goats, and cattle–a diet totally unlike the meat diet of the Late Archaic peoples. All in all, the results of this analysis were intriguing and suggestive (see Chapter 3, Section 4).

Zone B

Zone B is a thin layer of vegetal materials and/or dark brown refuse between 2 and 10 cm deep inside the rockshelter and blending into the top of zone F+ down the talus slope. As indicated in our typological charts, occasional prehistoric lithic and ceramic types occurred in this zone, but most artifacts were of modern times, roughly A.D. 1830-1910. These include nails, rifle shells and bullets, glass from both bottles and glasses, some burned bone, occasional crockery, and a piece of iron. Also, three posts about 6 inches in diameter and in a line about 1.5 m apart had been dug down (1-2 feet) into the eastern strata and a piece of barbed wire was nailed onto one. Further, the vegetal material contained much hay and straw, as well as a great deal of horse, mule, or burro dung. All this evidence leads me to suggest zone B represents the remains of a corral for horses, mules, and burros, perhaps when the one-room cottage, the ruined foundation of which is located about 150 m downstream on the same south bank of the canyon, was occupied from 1850 to 1910.

Zone A

Overlying zone B was a burned layer of modern refuse, including a dozen burned tires. Along with the glass, nails, iron, and shotgun shells was an occasional prehistoric object, which we earlier listed in our typology charts. This modern refuse, on the basis of types of modern bottle fragments, seems to show the layer deposit was laid down in the period from 1910 to 1987.

Summary

Todsen Cave gives us a glimpse of a series of occupations from 6000 B.C. to modern times. Of specific relevance to our research on the origin of agriculture in the Southwest are the spring season occupations during the Archaic peri-

od. The Fresnal zones J1, J, and F, as well as the Hueco zones E, E1, E2, and πJ, were of particular importance and had abundant artifacts and ecofacts. Although no corn actually was found in these zones, the presence of manos and metates suggests corn was part of the diet. The earlier Archaic levels–dating to Keystone and Gardner Springs times–were less well represented, but their limited data are important. Combined with data from excavations in Fresnal, La Cueva, and the Organ Mountain sites, our survey data indicate populations were small and occupations brief, so the Todsen Cave data, although limited, are proportionately large, and our analysis of these data provides an important start in the right direction.

Section 2

The Way of Life of the Occupants of Tornillo Shelter

The excavation of Tornillo Shelter in the southern end of the Organ Mountains was part of Upham's 1985 class program at NMSU. AFAR was assigned it in part because a looter had dug up some primitive corncobs there and exposed some possible Archaic stratigraphy. We therefore hoped to uncover evidence in the shelter of the way of life followed by early farmers in the Southwest. Instead, what we uncovered were brief summer task force occupations by people basically collecting wild plants–agave, yucca, and opuntia leaves. Three of these occupations–zones B, C, and D–were of the Fresnal phase, while one was a Hueco component overlaid by an ill-defined zone of more recent times. All had corncobs, however, giving us data about early evolution of corn races. We also garnered information about the weaving and stringmaking industries of these incipient agriculturists. These data filled out our picture of the Fresnal and Hueco phases and added a glimpse of the way of life followed by wet-season task forces to the data we had on Todsen's spring occupations.

The Way of Life of Zone D

Zone D–a layer of light brown scree, small flakes fallen from the roof of the shelter, and refuse–capped the rock floor of the shelter and ranged from 10 to 30 cm thick. It had no real floor on top of it and artifacts and ecofacts occurred at various depths within it, although most were concentrated in the upper 10 cm. Its composition and contents suggest the stratum was built up over a long period, near the end of which a number of task force groups briefly visited the shelter. Remains of bird bones, opuntia leaves and two flowers suggest these occupations occurred during the rainy season, perhaps August and September. A radiocarbon date of 1225 B.C. suggests these visits took place during the Fresnal phase.

We found various knots (11 square knots, three overlaid hand, and one granny) on yucca strands used as carrying loops; associated with them were 522 cactus leaves (yucca, opuntia, lechuguilla, or agave), suggesting these groups were collecting leaves both for food and raw materials for weaving (probably in their pithouse homes).

On their visits to Tornillo they engaged in numerous activities, including putting food in their mouths. The 137 bones mostly were rodent and avian (which may or may not have been collected). In addition were 17 jackrabbit bones, four deer bones, feathers, and a piece of deer hide, suggesting the consumption of meat derived from hunting as well as collecting and trapping, the last suggested by yucca strands with a slip knot that could have been part of a spring trap.

Even much more numerous were plant remains. We found 8,899 seeds, about half of them were tornillo or screwbean. Mesquite, opuntia, grass, and other seeds also occurred (in about that order of importance). Whether they were collected or accumulated in the cave naturally is difficult to discern, although I suspect the latter, but some could have been part of the food supply. Certainly many of the leaves were used as food: we found three quids, and 1,254 small plant remains–leaves, flowers, bark, mesquite pods, and the like–as well as 448 feces that might be human, many of them with seeds, leaves, or fiber in them.

Although it would seem these Fresnal peoples mainly were plant and animal collectors who did a little hunting, evidence that they grew domesticated plants comes from two gourd rinds, four cobs of proto-Maiz de Ocho and four cobs of Maiz de Ocho (perhaps comprising a lunch or supper prepared at home and carried on the collecting foray to Tornillo Shelter).

While in the cave, apparently they manufactured carrying loops for transporting the leaves to their homes. It seems they first used a flint disk to split the long cactus leaves into strands about 5 cm wide and then tied a square knot in one end, making a carrying loop 20-30 cm in diameter. Next, they either tied the two ends opposite the loop together to make a carrying device with loops at both ends or they tied the unlooped end to a middle strand to make a yokelike device.

They also may have chewed strands (or quids) to make soft fibers, which they then twisted into yarn. They also

made yarn of (three) soft fibers they did not have to chew. In addition, on the refuse they dropped a piece of twined bast fiber cloth that probably was woven elsewhere, an indication of textile weaving in Fresnal times.

We also have evidence the task force cut sticks and perhaps made six chips from the rhyolite of the cave walls.

The Way of Life of Zone C

Over zone D was a 5- to 20-cm-thick layer of brown soil with rock scree (zone C), capped by a vegetal layer about 5 cm thick, which we called floor 2, that seemed to cover all of the cave floor we dug. Floor 2 was the last part of the deposition of zone C. An obsidian date of about 900 B.C. suggests occupation by another seasonal Fresnal task force engaged in collecting leaves and seeds. Whether this occupation was a single visit or numerous ones is difficult to discern, but the plant remains suggest at least one brief visit by a small group in the summer wet season.

In addition to 46 animal bones, mainly from rodents and birds that may or may not have been collected for food, we found abundant plant remains and feces (some human and unanalyzed). The 3,814 seeds mainly were tornillo and mesquite, as well as a few cactus seeds that could have been brought into the cave naturally. We collected 218 leaves, mainly yucca (seven opuntia), that definitely had been carried into the cave; most had been cut by flint chips, and one was a quid. Delicate plant remains–leaves, flowers, roots, and the like–numbered 593, and may have been connected with food plant collecting. Two Maiz de Ocho cobs and two gourd rinds suggest domesticates supplemented the wild plant diet.

The major activity connected with the leaf collecting was the making of carrying loops to transport these objects. Coils and strands are evidence that task force members slit leaves and made them into loops by tying one of their ends with square knots. The splitting was done with the 12 flakes recovered, which were made on the spot by percussion blows, for we even found a worked rhyolite core.

We also recovered a couple of pieces of yucca cord and a fishtail style two-warp sandal, which had been left in the cave but probably not manufactured there.

The Way of Life of Zone B

Zone B was much like zones C and D, although it covered less space. It also seems to be of the Fresnal phase, but it contained a few more artifacts and ecofacts. The lower part of zone B, like zone C, was scree from roof fall combined with light brown refuse, 10-30 cm thick, that pinched out toward the (north) wall of the shelter as well as to the west. Its center portion, like zone C, was capped by a vegetal layer, floor 1, about 5-10 cm thick; this floor covered an area only about 2 m east and west and 1.5 m north and south in the southeast corner of our excavation. Most of the artifacts and ecofacts were found in floor 1, although some–particularly the seeds we found in our fine-mesh screens–occurred below, suggesting a series of short task force visits to the shelter in the wet season.

We found 151 bones, mainly rodent and avian, including two crane leg bones. There also were 14 rabbit bones and three possible deer bones, one of which had a cut mark on it. These bones provide evidence of collecting and hunting of animals as well as butchering, which probably occurred outside the cave. As in the other zones, seeds were abundant (7,694)–mainly tornillo, mesquite, and cactus–as were cactus leaves (810) and small delicate plant remains (788), including mesquite pods. The interlocking-stitch basket we uncovered may have been used to collect the seeds, and the carrying loops to hold the leafy foods. We also found a cucurbit peduncle, a gourd rind, and four corncobs of proto-Maiz de Ocho and Maiz de Ocho, indicating these people were incipient agriculturists.

Although the main manufacturing activity was making carrying loops, there were five sticks that had been cut and one shaved flat piece that might be part of an atlatl. A core, a possible hammer, seven flakes, 35 chips, and a Nogales point hinted the task force was flintknapping tools for woodworking, fiber cutting, and butchering during their sojourn(s).

We also found bark of many types and some string and cord that could have been made either in the cave or elsewhere and brought to the cave.

The Way of Life of Zone A1

Above floor 1 was a powdery layer of light brown refuse, only about 10 cm thick, covering only about 5 m^2 of our excavated layer, on top of which was a 5-cm vegetal layer, feature 1, that was spread over only about 3 m^2. While the other zones had looked like multiple occupations, zone A1 might be an occupation by a single task force during the wet season. An obsidian hydration date of 548 B.C. suggests it belongs to the Hueco phase, but the activities seem much the same as earlier ones.

Once again the bones collected (only 59) mainly were rodent and avian, although two larger ones could be jackrabbit, indicating collecting and/or trapping. Numerous seeds–4,974–again were mainly mesquite and tornillo, and the leaves were mainly yucca (276); delicate plants (360) included mesquite pods, small leaves, roots, and bark. Remains of gourds and corncobs indicated incipient agriculture.

One of the main activities, as before, was manufacturing carrying loops to transport the yucca and opuntia leaves. In addition, bundles of bast fibers and yarns and cords of bast fibers indicated the people also were rolling up their softer fibers into string. Although we recovered burned sticks, none seemed cut, so there was no woodworking, but 37 flakes and a possible hammerstone indicate some flintknapping–perhaps to make implements to cut leaves and fibers.

The Way of Life of Zone A

The top layer of scree and brown refuse, zone A, covered the whole floor of the shelter. Towards the mouth of the cave it was 10-20 cm deep and often overlay large slabs of rock (roof fall) that capped the floor of vegetal remains–feature 1. To the north, against the back wall of the cave, zone A thickened rapidly to more than 40 cm as feature 1, zone A1, and floor 1, over the upper part of zone B, were pinched out. The same occurred in the western portion of our excavation, while to the east zone A was a uniform 20 cm thick. Artifacts and ecofacts occurred at all depths within it, so it probably represents a relatively long period of time; two sherds and cane arrow shafts suggest this period began at least by A.D. 1200, during the El Paso phase. Although the zone may represent numerous visits to the shelter, the crane bone, corncobs, gourd fragment, opuntia flowers, and numerous seeds suggest those forays all took place in the wet season–perhaps July through September.

Hints of subsistence in this nebulous zone include 219 pieces of bone, 177 of which were bone splinters; only two thick pieces might have come from an animal larger than a jackrabbit. Eighteen of the bones seem to be of birds and three are crane leg bones, while 17 (four jaws, six skull fragments, and seven limb bones) were from rodents (which may or may not have been eaten); only three were long bones of jackrabbits. All of these animals could have been collected and/or trapped during the task force sojourns. The cane arrow shaft, however, indicates some hunting by bow and arrow.

Far outnumbering these possible food remains were those of wild plants. Two quids definitely had been chewed; with the 1,196 large plant remains, mainly yucca and/or agave leaves, were opuntia pods (a third of the remains), which could have been chewed as well as used as fibers for textiles. In fact, one of the main purposes of the zone A occupants may have been to collect leaves and pods and carry them in the numerous carrying loops or yokes to their homes.

Besides the possible leafy food or fiber materials were 3,651 small, delicate plant remains–grass stalks, bark, fibers, leaves, mesquite pods, and so on–that may have been connected with subsistence, been brought into the shelter for other purposes, or even just been blown into the cave. Equally difficult to interpret were the 11,553 seeds we collected–about 4,000 tornillo seeds, 3,500 mesquite seeds, 2,500 opuntia seeds, 1,000 grass seeds, and 553 unidentified seeds. Whether these seeds were brought in by humans or were blown and/or washed in by natural forces is unclear–I suspect the agent was natural more often than not. Four fragments of two kinds of baskets–one split stitch and one with an interlocking bundle foundation–could have been used to collect some or all of the seeds.

Evidence that these people consumed agricultural produce came from two Pueblo-type corncobs, gourd rind fragments, and a cucurbit peduncle. Although the evidence reaffirms that the El Paso phase people knew agriculture, as far as the cave occupation is concerned, these remains could represent a meager meal of corn-on-the-cob and a gourd container for carrying water.

In addition to collecting cactus leaves around the shelter, task force members made on-the-spot loops and yokes as carrying devices. Using a flint chip or convex scraper, they first slit the whole length of the yucca or agave leaves into strips about 5 cm wide and often wrapped those strands into coils. Out of some they made loops about 20 cm in diameter with a square knot on one end and the opposite end tied by a square knot to a similar carrying loop. A few fibers and quids suggest the people also chewed these strands to soften them and later twisted them into yarns (Z-twist or S-twist). On at least one occasion, they used a Z-twist to make two of these yarns into rope. Blum and Grange (Martin et al. 1952) suggest twisting often was done by rolling the yarn in the hand up or down against one's thigh.

We also found three yarns of cotton string, probably twisted by a spindle whorl (although we found neither the spindle whorl nor bundles of cotton). This activity probably was done elsewhere, as was the manufacture of two baskets, although we did have the strands of yucca or agave to be used in the interlocking or split stitches, as well as fibers and small sticks that could have served as the bundle foundations.

All the strands and the pieces of wood we found had been cut, probably with the 18 flint flakes, one sizeable flake (from the wall of the shelter), and the obsidian chip on the large convex uniface that shows dulling of its edge by slicing. It also seems probable that the flakes were made by percussion blows by a hammer against some sort of core (neither of which we found) in or near the cave.

Summary

Our excavation at Tornillo Rockshelter helped fill out our picture of the way of life of the Archaic Fresnal and Hueco peoples during the wet season on the high alluvial slopes. The excavation also provided information about the development of corn–from Chapalote to proto-Maiz de Ocho and Pima-Papago–crucial data for understanding the origins of agriculture in the Southwest. In addition, we now had some information about the weaving and stringmaking industries of the Late Archaic phases. Still lacking, however, were data on the Early Archaic, as well as fuller data on longer occupations in different seasons for all phases of the Archaic. North Mesa helped provide this necessary information.

Section 3

The Way of Life of the North Mesa Open Site Occupation

The North Mesa site was dug to fill out our picture of the earlier Archaic phases, Gardner Springs and Keystone. In addition to accomplishing this goal, it also gave us hints of earlier materials as well as more data on the Late Archaic phases, Fresnal and Hueco, in other seasons and with other activities than at Todsen and Tornillo. We also found meager hints of pre-Clovis and Clovis occupations, although these are not our main concern at present. However, the three Gardner Springs occupations–features 1 and 8 and upper zone C–gave us data that are germane to our understanding of the development of a seasonal scheduled subsistence system that led to agriculture.

Although these occupations still show an emphasis on hunting and butchering activities, evidence of the use of plants does occur and increases during the Keystone phase components–features 11 and 4 and lower zone B. This trend continued into the Fresnal phase components in middle zone B–including features 6, 9, and 2. Best represented was Hueco, the final Archaic phase, which had occupations in more seasons, as well as a greater diversity of subsistence activities. Feature 5, and perhaps features 3 and 10, reflected an emphasis on wet-season plant collecting; upper zone B in the central Trench showed an emphasis on winter hunting; and feature 7 was involved heavily with corn agriculture, an activity also found in feature 12, the final occupation (Mesilla phase) at North Mesa.

These various occupations are described in more detail below.

The Way of Life of Zone E

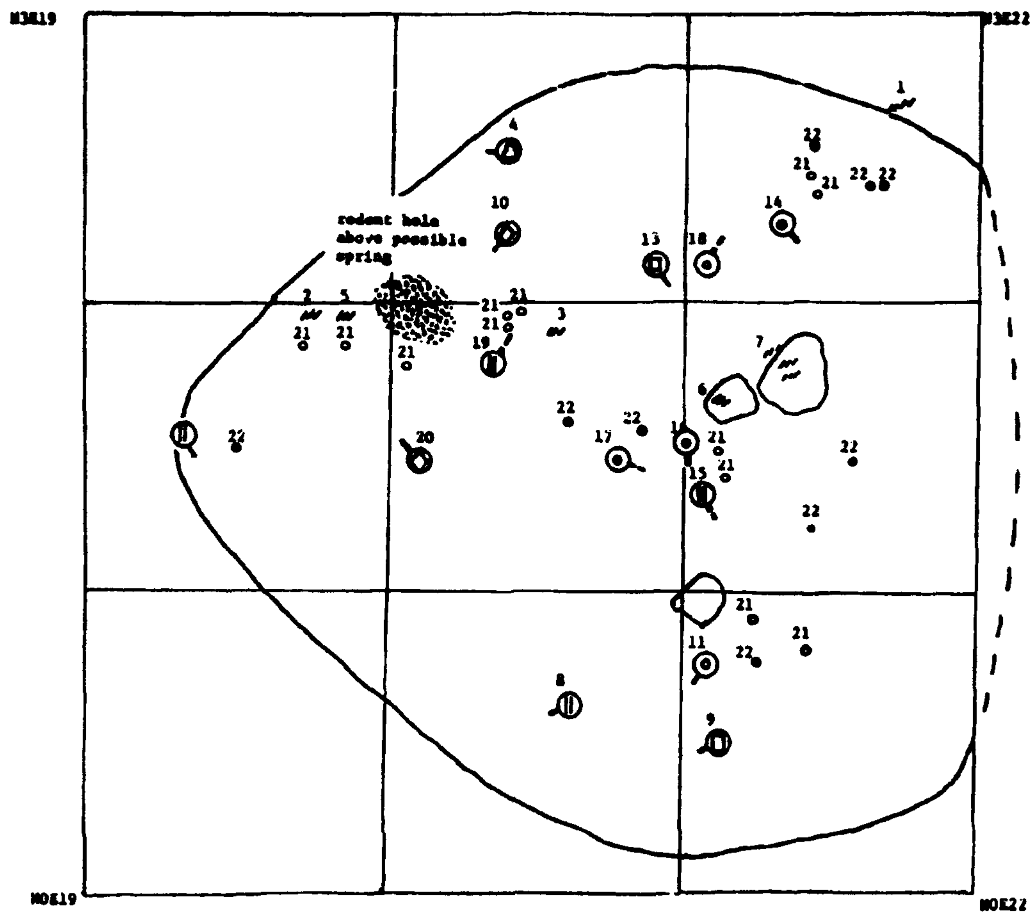
Evidence of the earliest occupation or occupations at North Mesa is both vague–no real floor or features–and unsatisfactory because of insufficient diagnostic artifacts or ecofacts. It occurred in zone E, which consists of fluvial sands around a spring or waterhole at about S2E20. The area around it reached a maximum thickness of about 30 cm and covered about 9.5 m^2, from N3E22 on the north to N0E21 on the south, N1E20 on the west, and N1E23 on the east. The size of the area suggests the component was the result of an occupation by a very small group–a microband or task force; the lack of floor and the varying depth of artifacts suggest more than one occupation, probably during the wet season, as signified by the presence of turtle and bird bones (see Figure V-7).

Evidence of activities during these forays is not numerous, although the Ayacucho unifacial type point, snapped by impacting, and the tooth of a large mammal suggest the people did some hunting. The bird and rodent bones may indicate the subsistence activity was supplemented by bird and rodent collecting (or trapping). Butchering of game seems closely connected to these subsistence activities, for we uncovered a flake and blade with evidence of cutting something medium-hard, like muscle or wet bone. Also, one chip showed evidence of slicing something medium and a bladelike flake had evidence of shaving the same sort of material.

The majority of tools and flakes, however, seemed to have been used on something hard, like bone, according to our use-wear study. Whether this use-wear occurred during butchering or whether it resulted from working bone into tools, or both, is difficult to discern, although the lack of bone tools tends to favor butchering. Pebble side scrapers or unifaces and a cleaver show evidence of adzing something hard, while a pebble chopper and a flake show evidence of chopping hard material, such as bone. A flake end scraper shows heavy use-wear at scraping something hard, like bone, while a blade, an end scraperlike chip, and a flake show evidence of shaving something hard.

Hints that these butchering tools were manufactured on the spot (mainly out of local rhyolite) are supported by a quartz hammerstone, 12 flakes, nine chips, seven chipped tools, and six utilized flakes. The evidence indicates mainly percussion chipping, with only a little pressure flaking on the unifacial point and snub-nosed end scraper.

Unfortunately, because our congery of artifacts is so small, classifying it into any cultural entity is difficult. Moreover, we lack date(s) on the zone, although stratigraphically it seems to occur before the Clovis occupation(s). We hope future research will supplement this meager information.



LA5529
Feature: None
Zone E
Phase: Pre-Clovis (?)
Date: Unknown

Seasonality: Wet Season - Turtle (1), Bird Bones (2, 3)

Activity *	Type of Use-Wear	
Hunting		
Ayacucho Unifacial Point (4)	Impacting Fracture	Hard
Unidentified Fragments of Large Mammal Bones (5), Large Mammal Tooth (6)		
Animal Collecting and/or Trapping		
Unidentified Bird (2, 3), Turtle (1), Small Mammal Bones (7)		
Butchering and/or Boneworking		
Pebble Side Scraper (8), Cleaver (9)	Adzing	Hard
Chopper (10), Large Flake (11)	Chopping	Hard
Blade (12), Pebble End Scraper (13), Flake (14)	Shaving	Hard
Flake (15)	Scraping	Hard
Blade (16)	Scraping	Medium-Soft
Chip (17)	Shaving	Medium-Soft
Flake (18), Blade (19)	Cutting	Medium-Soft
Flintknapping		
Quartz Hammer (20)	Pecking	
12 Flakes (21), 9 Chips (22)		

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-7. North Mesa: Zone E–Pre-Clovis Complex

The Way of Life of Zone D

Zone D was a thin deposit, always less than 10 cm deep, that was, like zone E, composed mainly of brown fluvial sands. Earl interpreted its brown color as the result of humic acid, which meant vegetation grew in the zone. Zone D capped most of zone E and covered only about 9 m^2, indicating brief occupation(s) by a small group or groups during the wet season, as suggested by the presence of bird bones.

The Clovis point (see Figure V-8) suggests hunting and the bird bone, animal collecting. Butchering is indicated by the pebble scraper with use-wear showing signs of chopping something hard and one snub-nosed scraper with evidence of scraping a hard object. The graver and two snub-nosed end scrapers show work on something medium-hard, perhaps skins. The pebble hammer, nine flakes, and two chips indicate the tools were made during the occupation(s). The sample is limited but the graver, snub-nosed end scraper with a lateral spur, and the Clovis point suggest the artifacts were deposited by Clovis peoples some 11,000-12,000 years ago. Obviously more data are needed as well as further excavation of this part of the site.

The Way of Life of Lower Zone C

This zone overlays the humuslike zone D and underlies the definite rock-paved feature 1 in the central trench. It ranges from 20 to 40 cm of light brown aeolian sands (probably blown in from the west) and is connected with zone C over the rock floor, zone X, that is found all over the site. In most areas zone C is only 10-30 cm thick, except for N8E23, where it is 1.25 m deep in feature 13, which had but a single ovoid chopper. In the central trench, however, zone C represents a well-defined block of time between zone D and feature 1, occupations that occurred in the transition from the Paleo-Indian period to the Archaic. Bird bones suggest those occupations occurred mainly in the summer wet season and activities at this time seem as limited as the earlier ones.

The Clovis point and four fragments of bones of a large mammal may indicate these people did some hunting, but most bone came from birds (eight), rodents, and jackrabbits, indicating collecting or trapping was a bigger activity.

One pebble muller, found at the very top of the stratum–perhaps associated with feature 1–may indicate plant collecting, but the evidence is not convincing.

In terms of use-wear, the major activity seems to have been butchering and/or boneworking. Four pebble cleavers and a large ovoid biface show evidence of chopping something hard. A wide variety of tools–a snub-nosed end scraper, two flakes, a large pebble chopper, a denticulated saw, four denticulated end scrapers, two small convex unifaces, and two large ones–indicate shaving against something hard, such as bone. Equally as numerous were tools with evidence of scraping hard, such as a flake, two denticulated end scrapers, and three pebble side scrapers.

Use-wear indications of working something relatively soft suggest the people may have been scraping skins. Such tools include gravers with evidence of drilling something soft, snub-nosed end scrapers, a flake, a denticulated saw, a blade with evidence of shaving or scraping something soft, and a large convex uniface that had cut something soft.

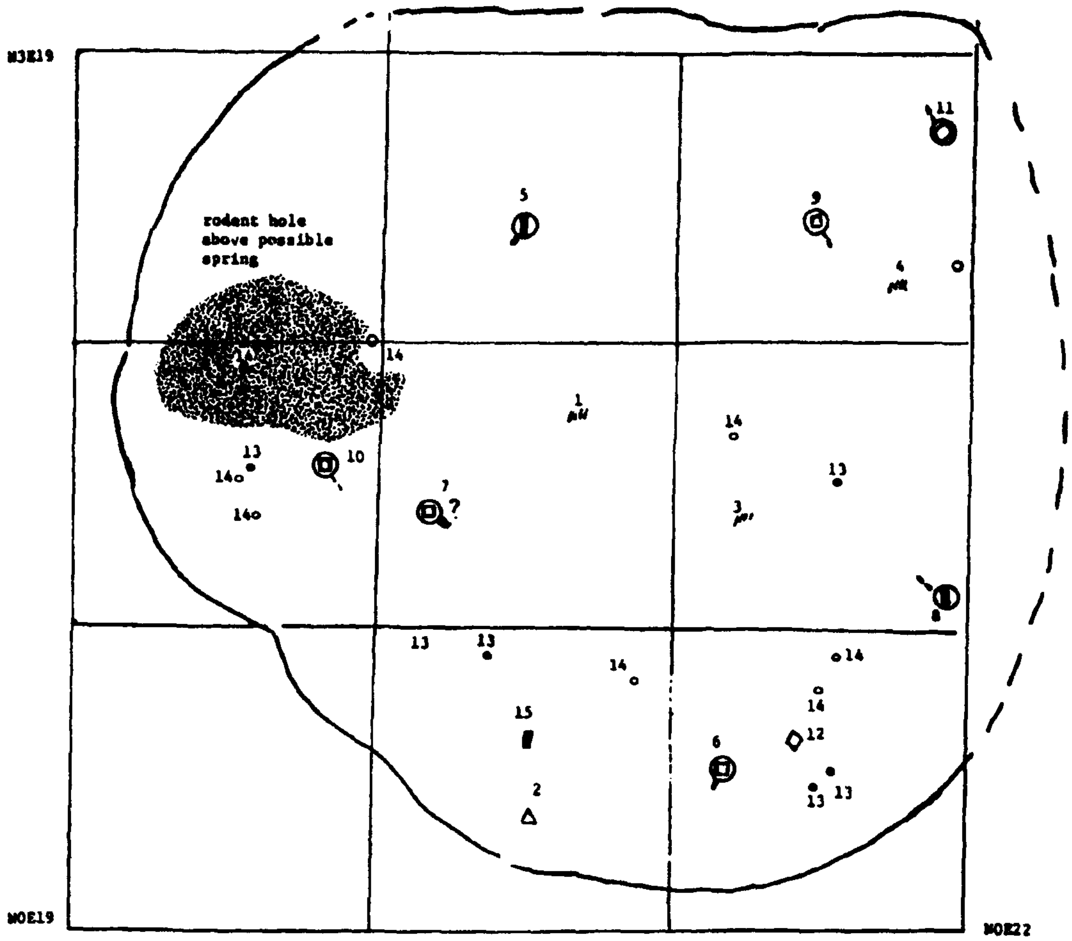
The possibility of woodworking is suggested by a large concave uniface and six flakes with evidence of shaving something medium-hard, a small convex uniface with signs of scraping, and two flakes with evidence of cutting something medium-hard.

The only other activity that seemed important during these summer visits seems to have been flintknapping, mainly of local rhyolite. Besides a pebble hammerstone with evidence of pecking something hard, like our three possible cores, we have 35 flakes and 51 chips (96 percent made of rhyolite), and an obsidian chip.

As with zones D and E, our data from Lower C are limited and nebulous. The time period falls somewhere between Clovis and the overlying Gardner Springs Archaic occupations of feature 1.

The Way of Life of Feature 1

Feature 1 was a pavement of flat rocks in a darkened sandy soil varying from 5 to 15 cm in thickness. It covered a roughly rectangular area from S5E19.6 to 0E24 to N2E24 to N2E20, about 11-13 m^2. In a few places (squares N1E21,



LA5529
Feature: None
Zone D
Phase: Clovis (?)
Date: 9000± 500 B.C.

Sesonality: Wet Season – Crane Leg Bone (1)

Activity *	**Type of Use-Wear**	
Hunting		
Clovis Flute Flake (2)		
Animal Collecting and/or Trapping		
Rabbit Bone (3, 4)		
Butchering		
Pebble Side Scraper (5)	Chopping	Hard
Pebble End Scraper (6)	Chopping	Hard
Possible Snub-Nosed End Scraper (7)	Shaving	Hard
Skin Preparing		
Graver (8)	Drilling	Medium
2 Snub-Nosed End Scrapers (9, 10)	Shaving	Medium-Soft
Flintknapping		
1 Hammer (11)	Pecking	Hard
1 Core (12)		
6 Chips (13)		
9 Flakes (14)		
1 Blade	No Use-Wear	

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-8. North Mesa: Zone D–Clovis (?) Occupation

N1E24, and 0E22) were reddish patches under the rocks, indicating burning; the darkening of the zone's soil may have been caused by charcoal (unfortunately never enough for a radiocarbon sample). Feature 1 is a definite occupational layer; its size indicates the occupying group(s) were small and the plant remains suggest a possible summer occupation. One of the main purposes was the roasting of foods–probably both plant and animal–on the rock pavement (see Figure V-9).

A few charred bones suggest roasting meat. We recovered Jay and Bajada points, and a large tip, but few tools with use-wear indicated butchering. Although a flake and a denticulate had evidence of shaving something hard, they could have been used to shave or shred hard yucca fibers or very hard wood. A half-moon biface and three flakes showed polish that indicated cutting something even softer, such as meat and/or leather, and a flake showed evidence of shaving the same kind of soft material. So the occupants may have cut meat for roasting–an interpretation I favor–or the tools could have been used to work leather. However, evidence of the possible preparation of meat was far outweighed by evidence of preparing vegetal remains for this slab roasting oven.

First of all, some of the fine bits of charcoal adhering to the fire-cracked slabs appear to be leaf fiber–either yuccalike leaves or possibly opuntia–and use-wear studies show the preparation of fiber (or wood) was a major activity. Two flakes, a snub-nosed scraper, a point tip, a denticulate saw, and a smaller flake were used to shave something medium-hard, such as plant fiber or wood. The blade, a small convex uniface, and a half-moon biface also showed evidence of cutting something medium-hard, such as wood or fiber–yucca, agave, or lechuguilla leaves–which then was roasted on the hot slabs.

One nebulous core, 23 flakes, and 12 chips suggest some of the tools for cutting were made on the spot.

The evidence of limited activities in feature 1 could represent those of a small task force group or groups during one or a few brief summer periods. The type of artifacts indicate these activities probably were undertaken by Gardner Springs peoples in the general period from 6000 to 4500 B.C. This glimpse of their activities, although limited, does add some information about a poorly known phase. Further data come from feature 8 of the rather different southeast trench and from upper zone C in the same central trench.

The Way of Life of Upper C, Central Trench

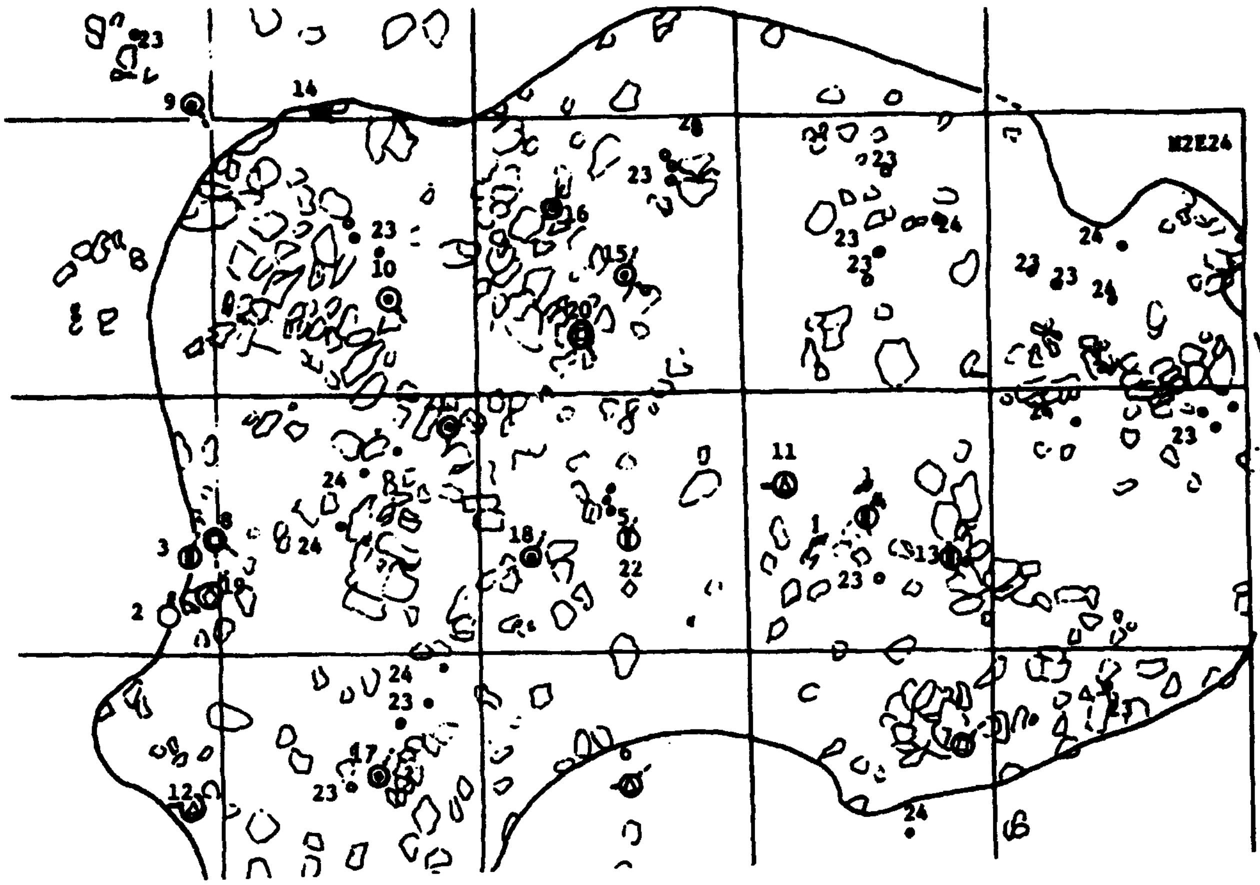
Upper zone C was not a finite occupational zone, consisting of light brown sands about 5-20 cm thick just below the dark brown of zone B and usually above rock-filled feature 1. Since upper C occurred all over the central trench with artifacts at various depths, determining the kind and size of occupation was difficult. Nevertheless, the activities of this Gardner Springs occupation are defined quite well.

Use-wear studies show most of the activities were concerned with butchering. A large ovoid biface and perhaps two hammerstones seem to have been used to chop something hard, such as bone, and the two blades and large and small convex unifaces show evidence of cutting something hard, like bone. Most surprising are the many kinds of tools with unifacial nicks and hinge fractures, suggesting they were used to shave meat off bone and became nicked when they scraped against the hard bone. These tools included a pebble side scraper, one denticulate saw, two denticulate end scrapers, two large flake end scrapers, and the small convex uniface. Similar use-wear occurred on another denticulate saw and end scraper, and two snub-nosed end scrapers, which also showed polish.

A hammerstone, two cores, 17 flakes, and 12 chips suggest these tools were made as needed, mainly out of local rhyolite.

In addition to meat preparation, we found evidence of plant use–a large boulder unifacial milling stone and two pebble mullers–an indication the people supplemented their diet with meal from ground-up seeds. These tools further suggest the occupations occurred during the wet season.

Still more information about the Gardner Springs people comes from feature 8 in the bottom of our southeast trench.



LA5529
Feature: 1
Zone C1
Phase: Gardner Springs
Date: 6000 to 4400 B.C.

Seasonality: Summer – Burned Fragments of Opuntia Leaves (1)

Main Function: Roasting Plants on Stone Slabs

Activity *

- Plant Collecting and Plant Food Preparation
  - Muller (2)
  - Blade (3), Small Convex Uniface (4), Large Convex Uniface (5)
  - Large Bifacial Point Tip (6), Denticulate (7)
  - Large Flake End Scrapers (8)
  - 2 Flakes (9, 10)
- Hunting
  - Point Tip (6), Bajada Projectile Point (11)
  - Jay Projectile Point (12)
- Butchering
  - Denticulate (13)
  - Flake (14)
- Butchering Meat and/or Skinworking
  - 4 Flakes (15, 16, 17, 18), Half-moon Biface (19)
  - Snub-Nosed End Scrapers (20)
  - Flake (21)
- Flintknapping
  - 1 Core (22)
  - 23 Flakes (23)
  - 11 Chips (24)

Type of Use-Wear	
Circular Grinding	Medium
Cutting	Medium
Sawing	Medium
Slicing & Scraping	Medium
Shaving	Medium
Impacting	Hard
Impacting	Hard
Slicing	Hard
Shaving	Hard
Cutting	Soft
Shaving	
Scraping	

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-9. North Mesa: Feature 1, Gardner Springs Phase

The Way of Life of Feature 8

Like the other Gardner Springs components, feature 8 occurred in the upper portion of zone C, 10-20 cm thick, in the southeast trench (see Figure V-10). The feature itself was defined as a concentration of fire-cracked rock that covered a 4-m-long by 2-m-wide area from roughly S8E27 to S11E31 in the light brown sands of zone C; it overlay an equally thick portion of zone C above the caliche rock base. Originally we treated the pit and the zone as separate entities, but since most of the artifacts of lower C were found under feature 8 and were of the Gardner Springs phase, and the two portions of artifacts in zone C fit together with two of those in feature 8, we suspect the artifacts and ecofacts of the feature and zone represent the same general occupational period.

A small task-oriented group or groups seems to have occupied a zone that lay under zone B; moreover, the southeastern portion lay under and was intruded into by feature 6 with its mainly burned base. We suspect the fire-cracked rock of feature 8 came from some sort of roasting pit, but found no burned soil except for the oven in feature 6. Thus the rock of zone C either came from a roasting pit outside the area of our excavation or from an earlier area directly under the burned soils at the base of feature 6. Either way, feature 8 was connected with a roasting area, as confirmed by the burned bones of rodents (six) and birds (four) in it. The bird bones also suggest this occupation or occupations occurred during the wet season and indicate that the people engaged in animal collecting and/or trapping.

However, a single fragment of a deer tooth and a Bajada point in zone A above the pit suggest hunting was a major subsistence activity, an interpretation that is substantiated further by the many tools with use-wear that suggests butchering and possible meat preparing.

Tools with evidence of being nicked by chopping a hard object include a large and small bifacial disk, a large flake, a battered corelike hammer, and a nebulous core. A scraper plane probably was used to adze something hard. The dominant evidence of use-wear, however, was of shaving against something hard, which suggests shaving meat off hard bone. Evidence of this appears on the above-mentioned scraper plane, the denticulated end scrapers, a denticulated saw, two pebble side scrapers, and a small convexly worked uniface. Another denticulated end scraper showed evidence of scraping a hard object, while a flake had cut something hard. It seems very likely the products of these butchering activities were roasted on the fire-cracked boulders of feature 8.

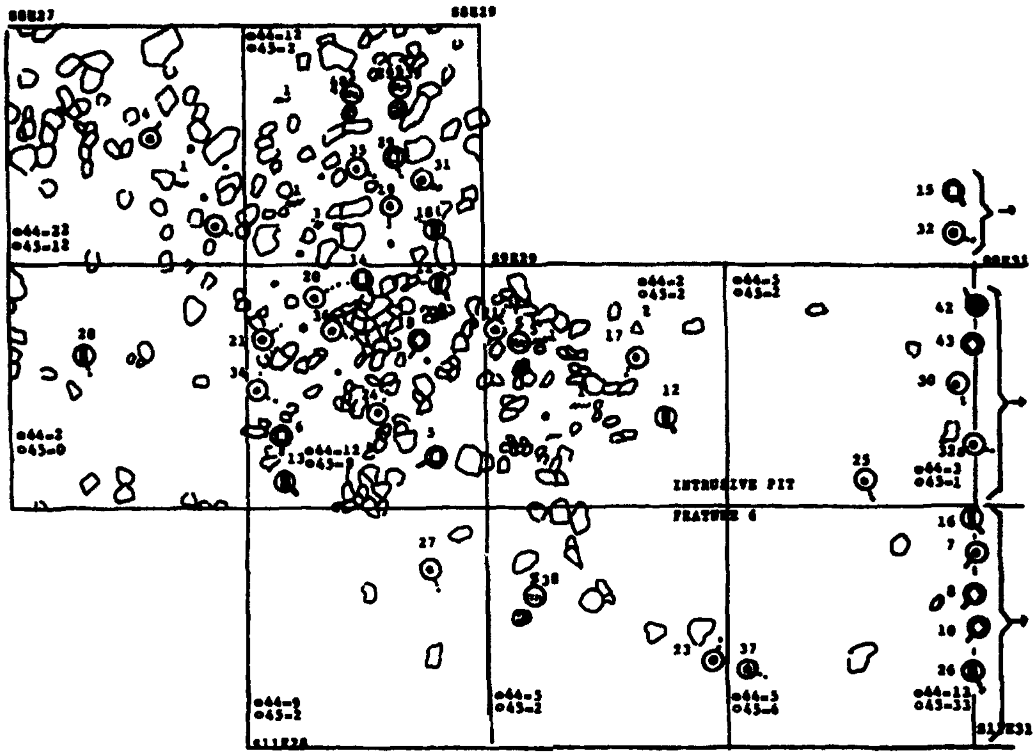
Further, evidence suggests many other tools were used to cut or slice something soft, such as meat or skins. Tools showing such wear include five flakes and a pebble uniface. Tools used to shave something soft include two snub-nosed end scrapers, two flakes, and a large convexly worked uniface. Another flake was used to scrape something soft. Showing similar use were three large convex unifaces that had cut something soft, two flakes that had sawed something soft, a graver that had drilled something soft, and a large flake that had chopped something soft. Determining whether these tools were part of the butchering process or were used in working hides is difficult; I suspect they may have been used for both activities.

Evidence that these Gardner Springs people did not live by meat alone comes from the end of a discoidal muller, and a pebble muller shows evidence of grinding hard seeds. Both were made from local river pebbles, whereas many of the chipped stone tools were of rhyolite. Representing the flintknapping industry were a pebble hammer, a core, 94 chips, and 82 flakes.

Feature 8, which gives us a further glimpse of the Gardner Springs occupations, is followed by the Keystone phase.

The Way of Life of Feature 11 and Associated Zone Lower B, Central Trench

Feature 11 was a small pit of boulders about 1 m long from N3E19 to N2E19.7; the pit was .5 m wide and about 30 cm thick (see Figure V-11). It was full of charcoal, had some burned bone of both large and small mammals, and contained two artifacts–a denticulate saw and a small convex side scraper–and many chips and flakes. Both artifacts and a flake showed use in shaving something hard, perhaps removing meat from a bone. The pit was dug down from the bottom of the dark sandy brown soil of zone B in the central trench, which had a few artifacts and ecofacts that may pertain to this brief task force occupation. These tools include a gouge and large flakes that had been gouged or shaved against something hard (probably during butchering) and a Lerma point, indicating hunting. One flake also



LA5529
Feature: 8
Zone C
Phase: Gardner Springs
Date: 5000 to 4400 B.C.

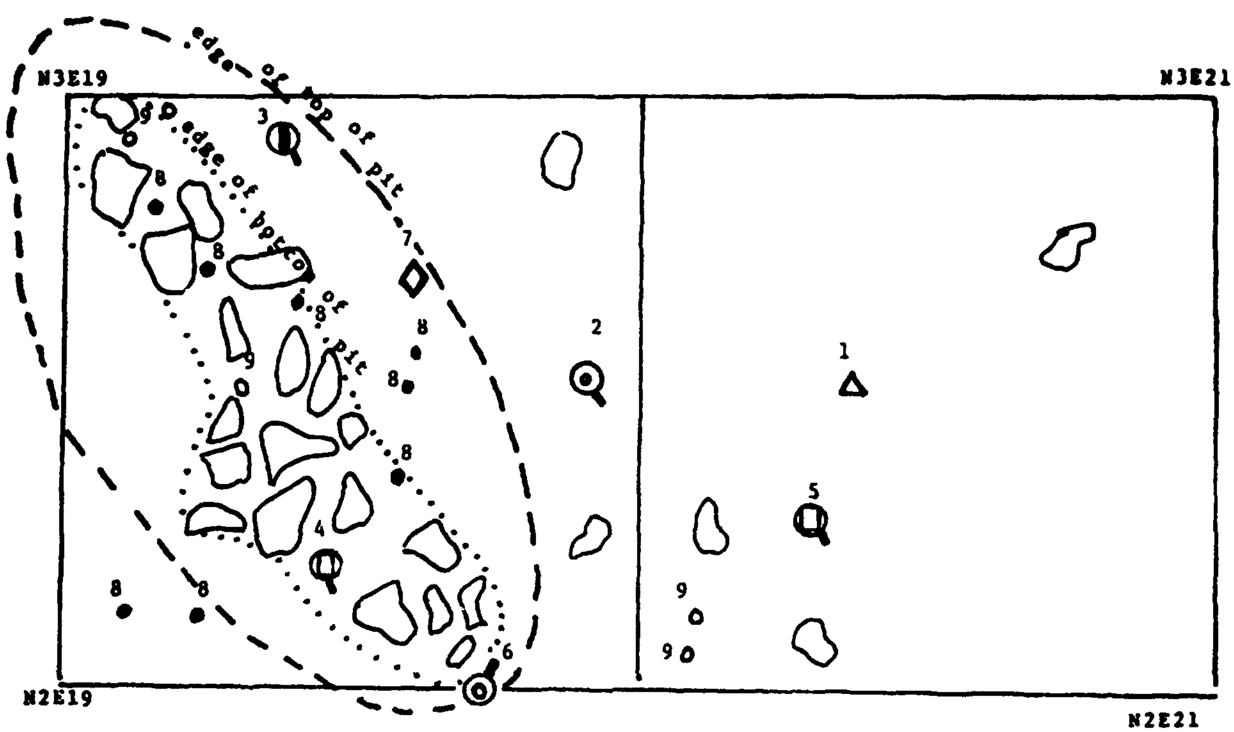
Seasonality: Spring-Summer Wet Season – 7 Burned Bird Bone Fragments (1)

Main Function: Roasting (mainly meat, but perhaps some plants)

Activity *	Type of Use-Wear	
Hunting		
Bajada Projectile Point (2) (found in Zone A, but probably originally from Zone C)		
Deer Tooth (3)		
Butchering		
1 Flake (4)	Cutting	Hard
1 Scraper Plane (5)	Adzing	Hard
1 Denticulated End Scraper (6)	Scraping	Hard
1 Flake (7), 1 Pebble End Scraper (8), Small Disk (9), Large Disk (10)	Chopping	Hard
2 Pebble Unifaces (11, 12), Small Convex Uniface (13), 1 Scraper Plane (14)	Shaving	Hard
1 Denticulated End Scraper (15), Denticulated Saw (16)		
Butchering Meat and/or Skinworking		
1 Flake (17)	Chopping	Soft
1 Graver (18)	Drilling	Soft
1 Flake (19)	Scraping	Soft
2 Flakes (20, 21)	Sawing	Soft
3 Large Convex Unifaces (22, 23, 24)	Cutting	Soft
3 Flakes (25, 27, 30), 1 Large Convex (28), 2 Snub-Nosed End Scrapers (26, 29)	Shaving	Soft
7 Flakes (31, 32, 33, 34, 35, 36, 37)	Slicing	Soft
Plant Collecting and Seed Grinding		
2 Discoidal Mullers (38, 39)	Circular Grinding	Hard
2 Pebble Mullers (40, 41)	Circular Grinding	Hard
Flintknapping		
1 Pebble Hammer (42)	Pecking	Hard
1 Core (43)		
94 Chips (44)		
82 Flakes (45)		

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-10. North Mesa: Feature 8, Gardner Springs Phase



LA5529
Feature: 11
Zone C1
Phase: Keystone
C14 Date: 2560 ± 80 B.C.

Seasonality: Winter – Lack of Plant Remains and Grinding Stones

Activity *	Type of Use-Wear	
Hunting		
Lerma Projectile Point (1) (same zone in nearby square)		
Burned Large Mammal Bones (same zone in nearby squares)		
Butchering		
1 Flake (2), 1 Denticulated Saw (3), 1 Small Convex Uniface (4)		
1 Gouge (5) (in adjacent square)	Shaving	Hard
1 Blade-Flake (6)	Cutting	Hard
Flintknapping		
1 Core (7)		
4 Flakes (9)		
13 Chips (8)		

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-11. North Mesa: Feature 11, Keystone Phase

showed evidence of cutting something hard, so butchering probably was another major activity. A pebble core, five flakes, and 13 chips suggest some of the butchering tools were made on the spot. The lack of grinding stones suggests a winter occupation or occupations.

Although the gouge, denticulate, and Lerma point suggest this occupation belongs in the Keystone phase, the best evidence placing it in this phase was a radiocarbon date of 2560 ± 80 B.C. (UCR2420). Further evidence of Keystone activities came from feature 4.

The Way of Life of Feature 4

Feature 4, which we initially called zone B3, was a burned clay area at the bottom of zone B that had fire-cracked rocks extending down into zone C (see Figure V-12). Its center was at S11E23, and it was about 1 m in diameter with a maximum depth of about 25 cm. Its stratigraphic position, when compared with the dated feature 11, suggests it was occupied during Keystone times; three blades, a denticulated saw, an end scraper, and a snub-nosed end scraper tend to confirm this hypothesis. The small area suggests a small group, and the presence of burned seeds may indicate a wet-season occupation even though no grinding stones were present.

In this feature of fire-cracked boulders and the adjacent portions of dark, lower zone B and uppermost C we found 17 artifacts, two cores, 91 flakes, and 344 chips. Almost half the chips and flakes occurred within the feature, but only one core and six artifacts were found in the pit itself. It therefore seems the artifacts and ecofacts may represent more than a single occupation; however, the activities represented by the artifacts both in the pit and in lower B were much the same.

Use-wear studies of seven of the artifacts indicated they were used against something hard, such as bone. Five of them–a large flake end scraper, a flat scraper plane, a pebble scraper plane, a denticulate end scraper, and a denticulate saw–have use-wear nicks indicating "slicing hard" and seem to have been used in shaving, probably cutting meat off bone. The two unifaces with a convex retouched edge–one large and one small–also seemed to have scraped against something hard. This evidence suggests butchering meat was a major activity of the Keystone people.

Seven of the other artifacts show evidence of use against something soft, perhaps meat. One blade seems to have cut something soft, while two other blades and a flake were used for slicing. One flake, however, seemed to have drilled something soft, such as skins, while the snub-nosed end scraper and a blade shaved a soft object that could have been either skin or meat. A small convexly worked uniface showed evidence of shaving something medium-soft, perhaps wood or fiber, but it could have been involved in butchering also. The tools recovered thus could have been used for butchering, working skins, or both–activities that involved working on the results of a kill.

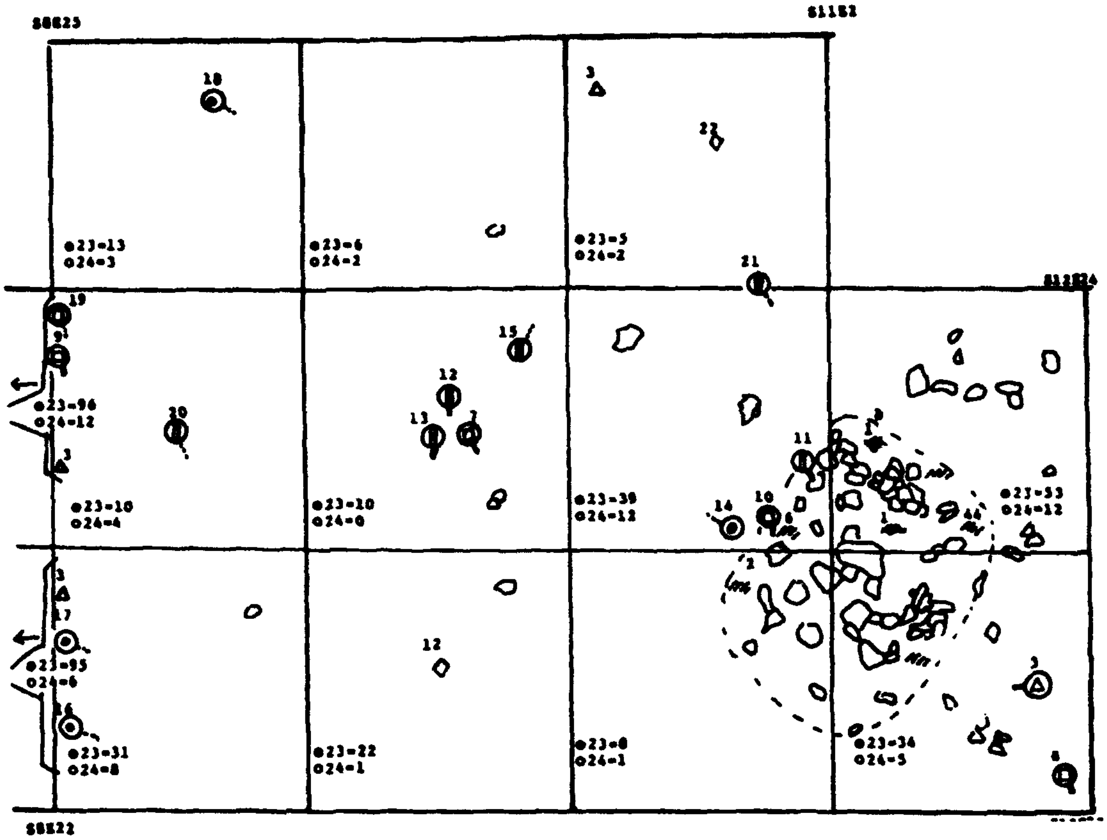
Evidence of kills include the split-up bones of deer and rabbit in association with the tip of a bifacial (dart?) projectile point and a pointed flake with a tip broken by impacting. The base of a Clovis point occurred in this same lower zone B, 5 m north of the roasting pit (feature 4), but we believe it probably was dug up from an older occupational layer (zone D?), since 16 of the 18 artifacts were not of Clovis types.

During the brief sojourns in the area of feature 4, many of the tools for the above activities probably were made on the spot. Evidence of flintknapping includes one core of rhyolite in association with 91 flakes and 344 chips, also mainly of local rhyolite.

Feature 4 thus is very much like feature 11, although it reflects an occupation during a different season. Feature 6, however, indicates a different way of life.

The Way of Life of Feature 6 and Middle B, Southeast Trench

As mentioned in the description of feature 8, a very distinctive slab-lined pit, feature 6, overlay it in squares S10E30, S11E30, S10E31, and S11E31 in our southeast trench (see Figure V-13). This pit seems to have been dug down from the middle of zone B, the artifacts and ecofacts of which we have included in this occupational analysis, and extended well into zone C, with the part of C lying under its slabs having been fired a bright orange. The small size of the feature and area occupied by artifacts and ecofacts indicates the presence of a microband.



LA5529
Feature: 4
Zone: Junction of C and B
Phase: Keystone
Date: 4300 to 2600 B.C.

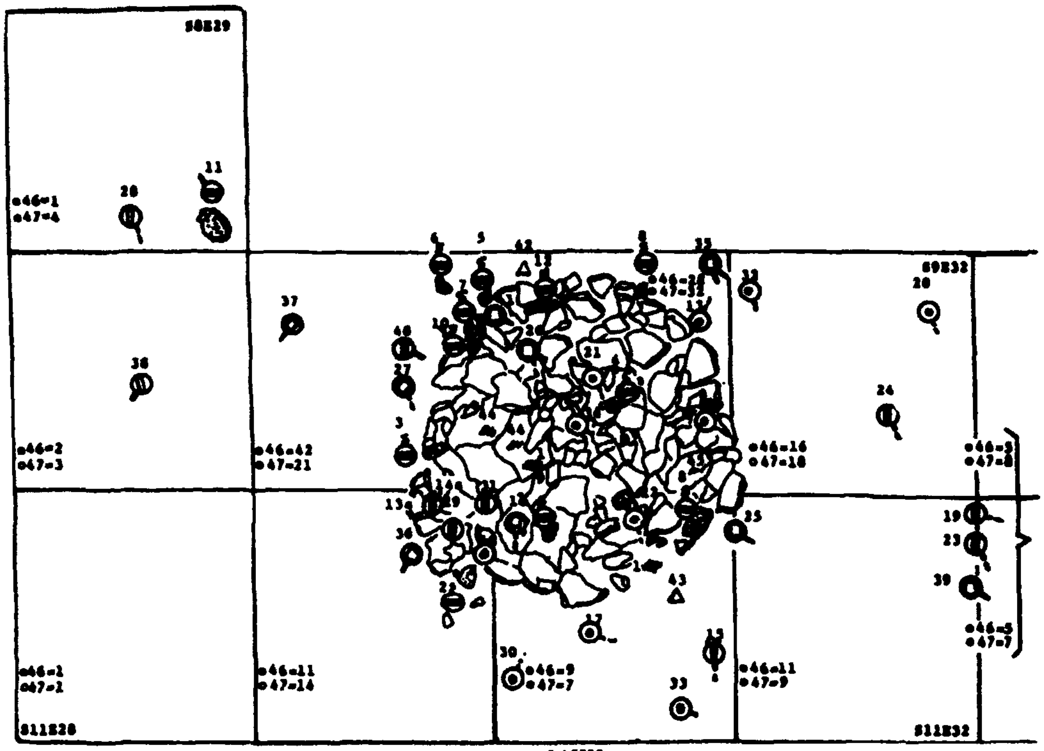
Seasonality: Spring – Burned Seeds (1), Bird Bone (2)

Main Function: Roasting on Boulders (mainly meat, but perhaps some seeds)

Activity *	Type of Use-Wear	
Hunting		
1 Tip of Projectile Point (3)	Broken by Impacting	Hard
Deer Bones (4)		
Animal Collecting and/or Trapping		
Small Mammal Bone (5), Large Bird Bone (6)		
Plant Collecting		
Seeds (1)		
Butchering		
1 Large Flake End Scraper (7), 1 Pebble Scraper Plane (8)		
1 Flat Scraper Plane (9), Denticulated End Scraper (10), Saw (11)	Shaving	Hard
1 Small Convex Uniface (12), 1 Large Convex Uniface (13)	Scraping	Hard
Butchering Meat and/or Skinworking		
1 Flake (14)	Drilling	Soft
1 Blade (15)	Cutting	Soft
3 Flakes (16, 17, 18)	Slicing	Soft
1 Snub-Nosed End Scraper (19), 1 Blade (20)	Shaving	Soft
Woodworking or Plant Fiberworking		
1 Small Convex Uniface (21)	Shaving	Medium-Hard
Flintknapping		
1 Core (22)		
344 Chips (23)		
91 Flakes (24)		

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-12. North Mesa: Feature 4, Keystone Phase



LA5529
Feature: 6
Middle Zone B
Phase: Fresnal
C14 Date: 1600± 80 B.C.

Seasonality: Wet Season – Wet Season Plants and Seeds (1)
Main Function: Roasting Plants

Activity *	Type of Use-Wear	
Plant Collecting and Plant Food Preparation		
2 Pebble Mullers (2, 3), 1 Discoidal Muller (4)	Circular Grinding	Hard
5 Milling Stones (5, 6, 7, 8, 9)	Circular Grinding	Hard
2 Anvil-Milling Stones (10, 11)	Circular Grinding	Hard
Elongated Mano (12)	Back-and-Forth Grinding	Hard
1 Flake (13), Blade (13a)	Cutting	Medium
1 Small Flake End Scraper (14), 1 Large Convex Uniface (15)	Scraping	Medium-Hard
3 Flakes (16, 17, 18), 2 Blades (23, 24), 1 Large End Scraper (25), 1 Small End Scraper (26), Small Biface (27), Large Concave Uniface (28)	Shaving	Medium-Hard
Butchering Meat and/or Skinworking		
1 Blade (29), 1 Flake (30)	Cutting	Soft
1 Blade (31), Flakes (32)	Shaving	Soft
2 Flakes (33, 34)	Slicing	Soft
Butchering		
1 Denticulate End Scraper (35)	Scraping & Shaving	Hard
1 Core (36), 1 Cleaver (37), 1 Pebble Side Scraper (38)	Chopping	Hard
1 Small Flake (26), 2 Large Flake End Scrapers (25, 39)		
1 Denticulate Saw (40), 1 Core (37), 1 Gouge (41)	Shaving	Hard
Hunting		
Chiricahua Point (42)		
Base of Lerma or Augustin Point (43)		
Large Mammal Bone (44)		
Animal Collecting and/or Trapping		
Small Mammal Bone (45)		
Flintknapping		
Cores (36, 40)		
131 Chips (46)		
124 Flakes (47)		

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-13. North Mesa: Feature 6, Fresnal Phase

At its top, the pit itself was about 120 cm in diameter, and about 90 cm at its slightly convex slab-lined bottom; its sides were lined with squarish one-foot-wide and -long slabs that sloped outward at a roughly 75° angle. Although the interior of its basin had an occasional rock, most of it was filled with charcoal and/or burned clay. The former was dated 1600 ± 80 B.C. (UCR2424) and indicated a Fresnal phase occupation, which is in agreement with the type of artifacts associated with the feature.

Included with the charcoal were about 16 pieces of burned bone, mostly of unidentifiable small rodents, although a fox and jackrabbit long bone also were identified, as was a jackrabbit jaw bone. These bones suggest some collecting of small mammals, while a badly burned Chiricahua point from above the pit and a pointed base of a projectile point in middle zone B–which we classified as Lerma-like, but which just as well may be the stem of an Augustin point–do indicate some hunting also might have occurred.

Much more numerous than bone, however, was burned fiber of yucca or agave and seeds. These ecofacts not only indicate feature 6 mainly functioned as a roasting pit for plants, but that a major activity of this small task force was plant collecting in the wet part of the summer season.

Food-preparation tools and use-wear indications confirm this estimate. Included in the fill of the pit were a pebble muller, a discoidal muller, and a broken milling stone, while the lining of the pit included another pebble muller, four fragments of unifacial boulder milling stones, and two anvil-mortar milling stones. All have been ground round and round and have the sort of luster on their surface that indicates they were used for grinding hard seeds, such as those of cactus, opuntia, and grass. One elongate pebble mano that occurred in the fill had been ground back and forth, and its luster suggests the possibility that small amounts of corn might have been ground, but the evidence hardly is conclusive.

Our use-wear study tends to confirm the idea that the task force concentrated on working plants, for many tools seem to have been used to work medium objects, such as plant fibers or soft wood. In fact, the most numerous type of use-wear was "shaving medium hard" (that is, shaving opuntia, yucca, or agave leaves); this wear showed up on three flakes, a large and a small flake end scraper, a large concave uniface, and a small bifacial disk. One flake end scraper had been scraped against something medium-hard. Also common were tools that had sliced something medium-hard, for example, cutting leaves to lay on the hot coals of feature 6; these included four flakes, a small convex uniface, and small flake end scrapers. A flake and two crude blades showed evidence of cutting something medium-hard, that is, cutting leaves to lay on the coals in the slab-lined roasting pit. These tools comprised an impressive list and indicated that in this feature of the Fresnal phase people were engaged in activities differing somewhat from those of the previous Keystone or Gardner Springs phases.

Some evidence, however, indicates that the type of activities found in Keystone and Gardner Springs continued. A number of flaked tools showed nicks and wear indicating working something hard, such as bone. These tools included two large flake end scrapers, a denticulated saw, a core, a gouge, and a crude blade that had shaved something hard; denticulated end scrapers had scraped a similar material. In addition, three tools–a core, a pebble chopper, and a cleaver–had been used to chop something hard.

Evidence for cutting a soft object, such as leather or meat, appears on two flakes ("slicing soft") and a blade; a large flake end scraper had shaved something soft, while a blade and flake had "cut soft."

A pebble hammerstone, two cores, 134 flakes, and 131 chips indicate tools were made on the spot, mostly of local rhyolite, although a few were of chert or quartzite, and a couple of chips were obsidian.

Feature 6 of the Fresnal phase reflects a subtle shift from an emphasis on meat processing to activities concerned with plants as well as a hint of possible use of domesticated plants (corn?).

Way of Life of Feature 9 and Associated Middle Zone B, Central Trench

Feature 9 was a large conical pit 1 m in diameter with its center at N2E20, which had evidence of burning in the bottom and was full of refuse. The feature represents an occupation or occupations by a small group; the lack of seeds or grinding stones suggests this occupation occurred in the winter dry season. The feature was some sort of open-fire cooking pit, and the activity surrounding it again was mainly butchering. Most of the evidence for this activity, however, comes from the middle of the dark sandy zone B that surrounded the feature. The pit itself had but a single small convex uniface that had shaved something hard, and some flakes, chips, and bone.

Nearby, however, was an Abasolo point associated with deer bones, a fox tooth, and a crane leg that might mean the people hunted down the game they butchered and then barbecued. A pebble chopper and a large convex uniface show bifacial battered edges–evidence of chopping something hard, such as bone. Abundant evidence of shaving a hard object (bone) appears on two flakes, one small convexly worked uniface, a denticulated saw, a flake scraper plane, a large convex uniface, and a back-blunted unifacial knife. This knife also shows evidence of cutting something hard, as does a crude blade; another large convex uniface has wear, indicating it was used to saw something hard, such as bone. These tools provided ample evidence of butchering meat to prepare it for roasting.

The core, the bifacial knife that could be a quarry blank, 31 chips, and 22 flakes may indicate some of these butchering tools were made on the spot during a brief sojourn.

Although the artifacts are not very diagnostic of the Fresnal phase, a date of 1495 ± 90 B.C. (UCR2421) indicates feature 9 probably was made by peoples of this cultural phase.

The Way of Life of Feature 2 and Middle Zone B, South Trench

Feature 2 was a large steep-sided pit, 2 m long and 1.5 meters wide, oriented southwest-northeast (see Figure V-14). It was filled with fire-cracked boulders and charcoal and extended from the middle of zone B for about 40 cm, well down into zone C, in the south trench in squares S10E23, S9E24, S10E24, S9E25, and S10E25. About 20 artifacts were found in or near the pit; another 13 were found at about the same level or the top of the pit in zone B, and the chips, flakes, cores, and ecofacts had a similar distribution. It is difficult to tell whether this was a single occupation or a series, but since the area involved was small, the occupation or occupations probably were by (a) microband(s) or task force(s). The numerous bird bones suggest this occupation occurred during the spring.

As to the subsistence pattern of the inhabitants, the evidence for plant collecting is slightly more prevalent than that for hunting or animal trapping/collecting. Found in the pit were three small rectangular slab manos and a unifacial slab metate. All had been ground back and forth as had a paint palette that also could have been a mano; all the hand stones, however, are too light to have been used to grind hard corn kernels so the people probably were grinding some sort of wild plant seeds. Although these grinding stones were associated with feature 2, we do not believe they were involved with the main function of the pit, which was roasting wild plant leaves. As evidence of this activity we found fragments of charred leaves of opuntia, yucca, and/or lechuguilla in the pit, and the majority of tools with use-wear show evidence of having been used to work something medium, such as plant fibers. The majority of these tools had shaved something medium-hard; they included two small convex and one large convex uniface, a large flake, a small and a large flake end scraper, a pointed uniface, and a spokeshavelike uniface. Further, a large concave uniface had scraped something medium-hard, while another small convex uniface had sawed something similar.

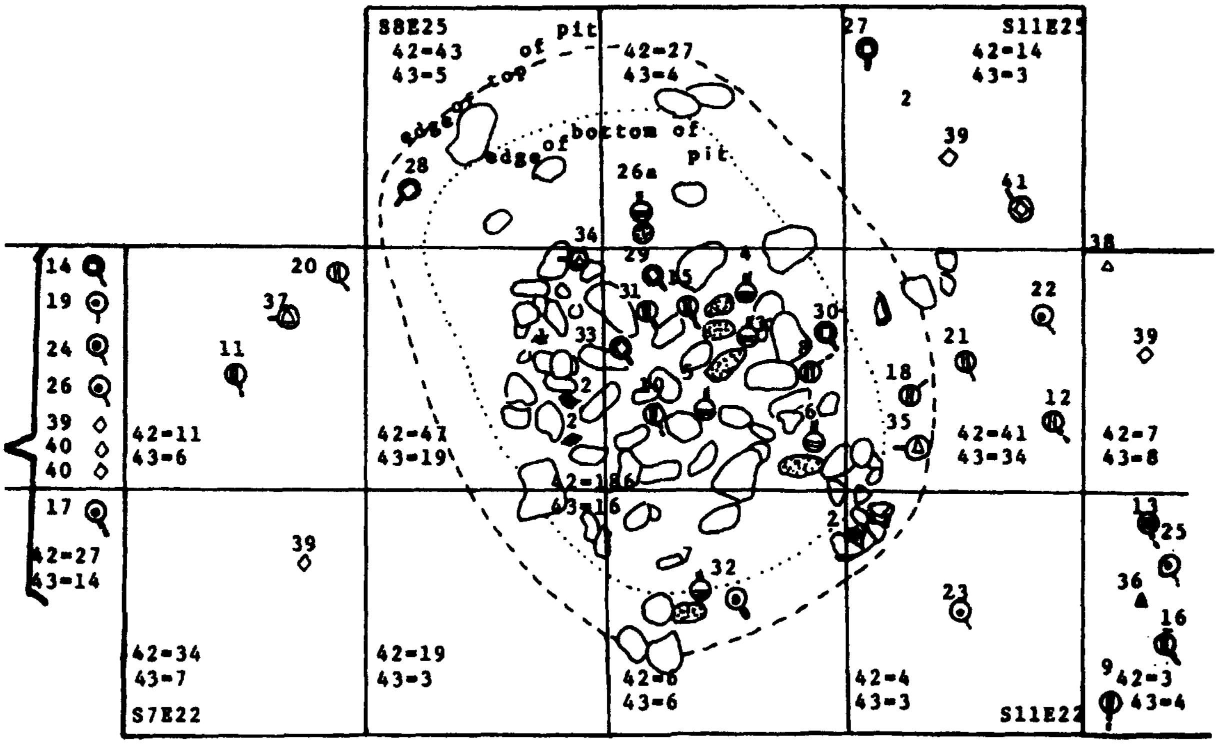
Almost as numerous were tools and flakes used for working something soft. Two blades and five flakes showed luster resulting from shaving something soft, while another blade had sawed a soft object and a flake had scraped something soft. Whether these tools were used on meat, wet skin, or soft plant remains was difficult to determine, but in any case they probably were involved in food preparation–getting food ready to be placed on the hot rocks of pit 2.

Evidence for butchering animals includes a discoidal flake chopper and a small bifacial disk with signs of chopping something hard. A large flake, a cleaver, a flat scraper plane, and a large concave uniface had shaved against something hard, and a small flake end scraper had scraped something hard. These tools occurred in association with burned bones of birds and rodents, and long bones of larger mammals, probably deer, indicating the pit was used for roasting meat as well as plants.

The small bones suggest much meat was collected or trapped, but the big bones found in association with three large point fragments, as well as an Augustin and a Chiricahua point, indicate the people did some hunting.

There is considerable evidence that many of the tools used in the above-mentioned activities were made on the spot, mainly from local rhyolite. In addition to three cores and two pebble hammers, there were two rhyolite quarry blanks, 472 chips, and 132 flakes.

This glimpse of the summer activities of a Fresnal task force reflects a subtle shift from roasting mainly meat to a concern with roasting plants.



LA5529
Feature: 2
Zone Middle B
Phase: Fresnal
C14 Date: 1260 ± 90 B.C.

Seasonality: Wet Season – Bird Bone (1), Seeds and Corn Grinding Tools
Main Function: Roasting Plant (Leaves) Foods (2)

Activity *	Type of Use-Wear	
Plant Collecting and Plant Food Preparation		
2 Rectangular Manos (3, 4), Slab Metate (5), Paint Palette (6), Possible Mano (7)	Back-and-Forth Grinding	Medium
1 Small Convex (8)	Sawing	Medium
1 Large Concave (9)	Scraping	Medium
2 Small Convex (10, 11), Large Convex Uniface (12), Large Flake (14), Small Flake End Scraper (13)	Shaving	Medium
1 Small Pointed (15), Spoke Shave (16), Flake (17)	Shaving	Medium
Preparing Soft Meat, Plants and/or Skinworking		
1 Blade (18)	Sawing	Soft
1 Flake (19)	Shaving	Soft
2 Blades (20, 21), 5 Flakes (22, 23, 24, 25, 26)	Shaving	Soft
Discoidal Muller (26a)	Circular Grinding	Hard
Butchering		
Small Flakes (27)	Scraping	Hard
Discoidal Biface (28), Small Disk Biface (33)	Chopping	Hard
Cleaver (29), Scraper Plane (30), Large Concave Uniface (31), Flake (32)	Shaving	Hard
Hunting		
3 Large Mammal Bones		
Chiricahua Point (34), Point Tip (35)		
Augustin Point (36), Point Tips (37, 38)	Impact	
Animal Collecting and/or Trapping		
7 Small Mammal Bones, 8 Bird Bones		
Flintknapping		
3 Cores (39)		
3 Blanks (40)		
2 Hammers (41)		
132 Flakes (43)		
420 Chips (42)		

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-14. North Mesa: Feature 2, Fresnal Phase

The Way of Life of Feature 5 and Upper Zone B, Southeast Trench

Feature 5 was a deep pit with steep, almost vertical sides extending down from upper zone B at least 10 cm into zone C. It was about 2 m long, from S9.8E31.75 to S10E33.5, and about 1.5 m wide, from S9.4E32.5 to S10.5E32.5. The pit was filled with fire-cracked boulders, dark brown in color, with flecks of charcoal and burned clay, the latter mainly in the bottom. There were only a few artifacts, but many ecofacts (chips) in the pit itself, while upper zone B at either end of the top of the pit contained the majority of the tools and ecofacts, which supports the idea that the pit might have been used over and over again by small groups (see Figure V-15).

A couple of burned bones–of a bird or small mammals–and possible small (Hatch?) projectile point fragments suggest hunting or animal collecting and/or trapping was a minor activity. This idea is strengthened by the fact that only a few tools might have been used in butchering game–a gouge, large flake end scrapers with use-wear indicating shaving something hard, and a flake end cleaver with evidence of chopping something hard. Whether these tools were worn by use against bone or hard wood is difficult to determine, but the quite large fragments of charcoal in the fill suggest it might be the latter.

Other evidence of subsistence included an elongate mano with wear indicating grinding back and forth–hinting at the grinding of corn and/or other plant remains. The radiocarbon date of 460 ± 100 B.C. (UCR2425) suggests the presence of corn, and the plant remains hint that the occupations occurred in the wet season.

The major activity in feature 5 seems to have been roasting something on the rocks in the pit and preparing this something for roasting. A few burned fibers and a burned opuntia pod plus use-wear on a number of tools suggest the object prepared and roasted was agave and/or yucca leaves and/or opuntia leaves, but it could have been corn. Two large flakes, a small convex uniface, and a large concave uniface have worked edges showing gloss caused by shaving something medium-hard, such as fibers or a cornstalk, and a flake and a large convex side scraper show evidence of scraping similar materials. Another flake showed polish and wear indicative of sawing plant materials. A main activity thus seems to have been cutting up leaves and possibly corn so they could be roasted over feature 5.

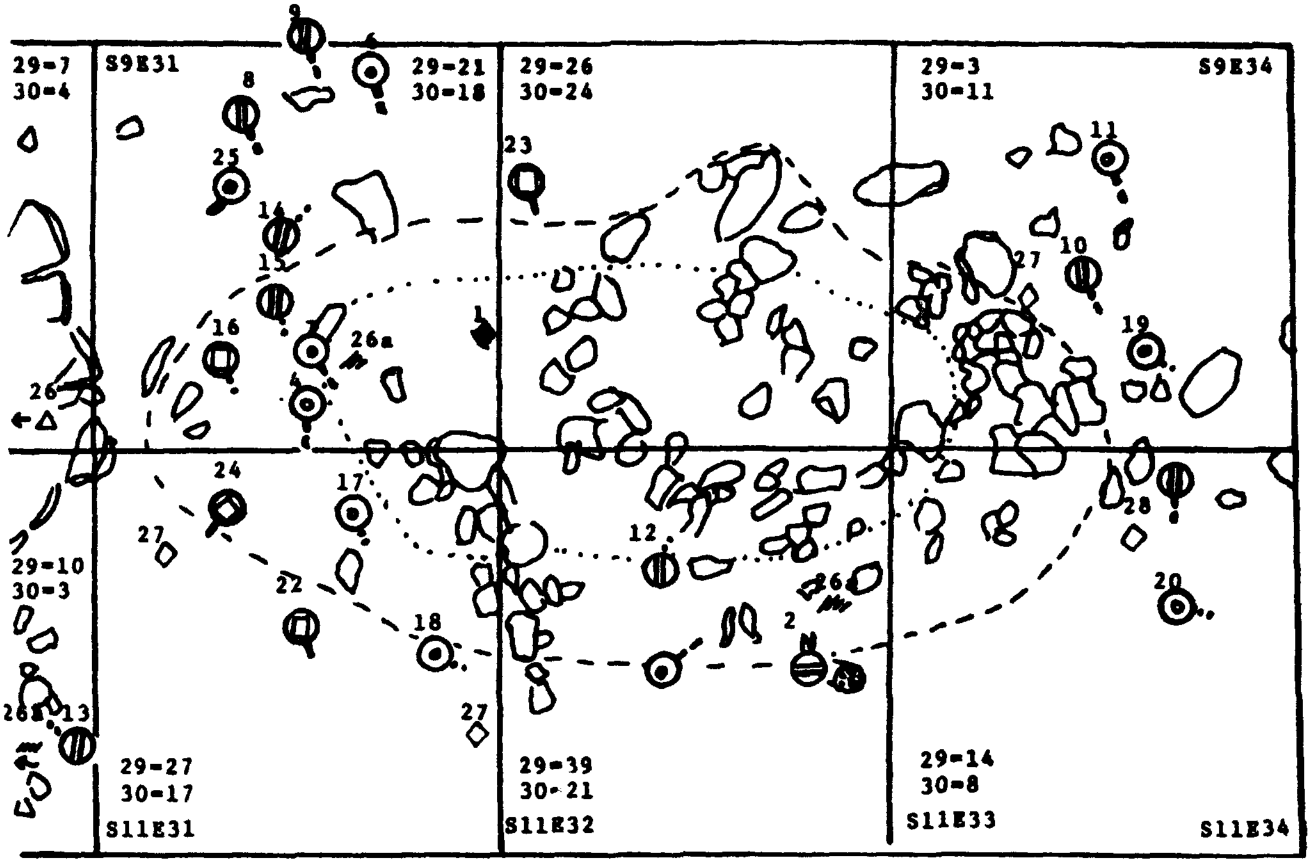
In terms of number of tools or flakes with evidence of use-wear, however, the majority show evidence of working something soft. Three flakes, a blade, a small convex uniface, two large convex unifaces, and a flake with a concave smoothed area were used to slice something soft, such as wood or wet skins; the concave scraper suggests the object might have been wood rather than skins. Although a small pointed flake showed evidence of drilling something soft, suggesting skins were being pierced, this tool could have been used to drill holes in soft wood. A flake showed evidence of cutting something soft, such as either wood or leather. Perhaps tipping the scales in favor of woodworking were two flakes, a flake end scraper, and a spokeshavelike concave uniface that showed evidence of shaving something soft.

Many of these tools, whether used for woodworking or food preparation, seem to have been made on the spot, for we found three cores, a possible quarry blank, 147 chips, and 106 flakes (mainly of local rhyolite).

Both the tools and the date of 460 B.C. indicate a Hueco phase occupation. While the activity of preparing food was much the same as for other features at North Mesa, the evidence for woodworking tells us something new about the way of life.

The Way of Life of Features 3 and 10 and Zone B, North Trench

This northern area first was tested in 1988, when feature 3 was uncovered in squares N8E23, N9E23, and N10E23. It was a large charcoal-darkened area that intruded 40 cm down from the top of zone B into zone C. At various times it was considered a pithouse, a large roasting pit, pits 3 and 10, and a hearth, but as we dug in it in 1989, it became apparent that a large tree had burned in this region and the charcoal might be its remains. Just about the time we decided it was not a feature of human occupation, we found a small burned hearth, conical in shape and about 60 cm in diameter and 30 cm deep, under stake N4E23. This hearth was evidence of a brief occupation by a small group, and the unifacial slab metate for grinding seeds suggests the foray occurred during the wet season.



LA5529
Feature: 5
Zone Upper B
Phase: Hueco
C14 Date: 460 ± 100 B.C.

Seasonality: Spring-Summer Wet Season – Plant Remains (1)
Main Function: Roasting Plants on Rocks in a Pit

Activity *	Type of Use-Wear	
Plant Collecting (including corn) and Plant Food Preparation		
1 Elongate Rectangular Mano (2)	Back-and-Forth Grinding	Medium-Hard
1 Flake (3)	Sawing	Medium
1 Flake (4), 1 Large Convex Uniface (5)	Scraping	Medium
3 Flakes (6, 7, 11), 1 Large Convex Uniface (10), 1 Small Convex Uniface (8), 1 Spokeshavelike Uniface (9)	Shaving	Medium
Preparing Soft Meat, Plants and/or Skinworking		
1 Blade (12)	Cutting	Soft
1 Small Pointed Uniface (13)	Drilling	Soft
1 Blade (14)	Sawing	Soft
1 Large Concave Uniface (15), 1 Large Flake End Scraper (16), 1 Flake (17)	Shaving	Soft
3 Flakes (18, 19, 20), 1 Large Convex Uniface (21)	Slicing	Soft
Butchering		
1 Gouge (22), 1 Large Flake End Scraper (23)	Shaving	Hard
1 Cleaver (24), 1 Large Flake (25)	Chopping	Hard
Hunting		
1 Projectile Point Fragment (26), Large Mammal Bone (26a)		
Animal Collecting and/or Trapping		
Bird Bone and/or Small Mammal Bones		
Flintknapping		
3 Cores (27)		
1 Quarry Blank (28)		
147 Chips (29)		
106 Flakes (30)		

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-15. North Mesa: Feature 5, Hueco Phase

Since artifacts and ecofacts were not numerous, determining the activities of the occupation was difficult. The fragment of slab metate obviously suggests grinding seeds or corn, while the point tip suggests hunting. Other activities, however, are not well represented. In the general pitlike area was a small flake end scraper with use-wear indicating scraping a hard object, while near pit 10 were another flake with the same kind of use-wear, large convex unifaces, and a flake that had sliced something hard. In this same hearth we found three flakes that had sliced something soft, and a flake that had shaved a similar material, while a blade in feature 3 had sliced something soft. All this evidence of use-wear could indicate the people did some butchering in the area, but the evidence hardly is conclusive.

Around feature 10 were 21 chips and 14 flakes, suggesting flintknapping, but not documenting it adequately.

In fact, the artifactual evidence that this occupation was of Hueco times is not very satisfactory; we are dependent on its stratigraphic position in upper zone B for this tentative classification. A better documented occupation appeared in nearby upper zone B in the central trench.

The Way of Life of Upper Zone B, Central Trench

Three to 4 m to the south of features 10 and 3, and at roughly the same depth (10-30 cm), in upper zone B in the central trench, was a concentration of projectile points–two Hatch, a Padre Gordo, an En Medio, a San Pedro large, and an Armijo–that definitely allow the zone to be classified as Hueco. This concentration of artifacts occurred in 9 1-m squares, from S1E22 to 0E22 to 0E20 to N1E23, and seems to represent the activities of a small group in one or more occupations; the lack of grinding stone suggests these occupations occurred during the fall and/or winter.

The major activity in terms of use-wear was shaving soft, evidence of which occurred on three flakes, a denticulate saw, and a large pointed uniface. The uniface, a blade, and a large convex uniface all showed evidence of slicing something soft. A large pointed uniface and a small convex uniface had evidence of sawing soft objects. These tools, plus large flake end scrapers, suggest a major activity was working the skins of animals killed with the numerous projectile points. Although a few pieces of large burned bone were found, none could be identified, so we do not know what animals were killed or what kinds of skins were worked.

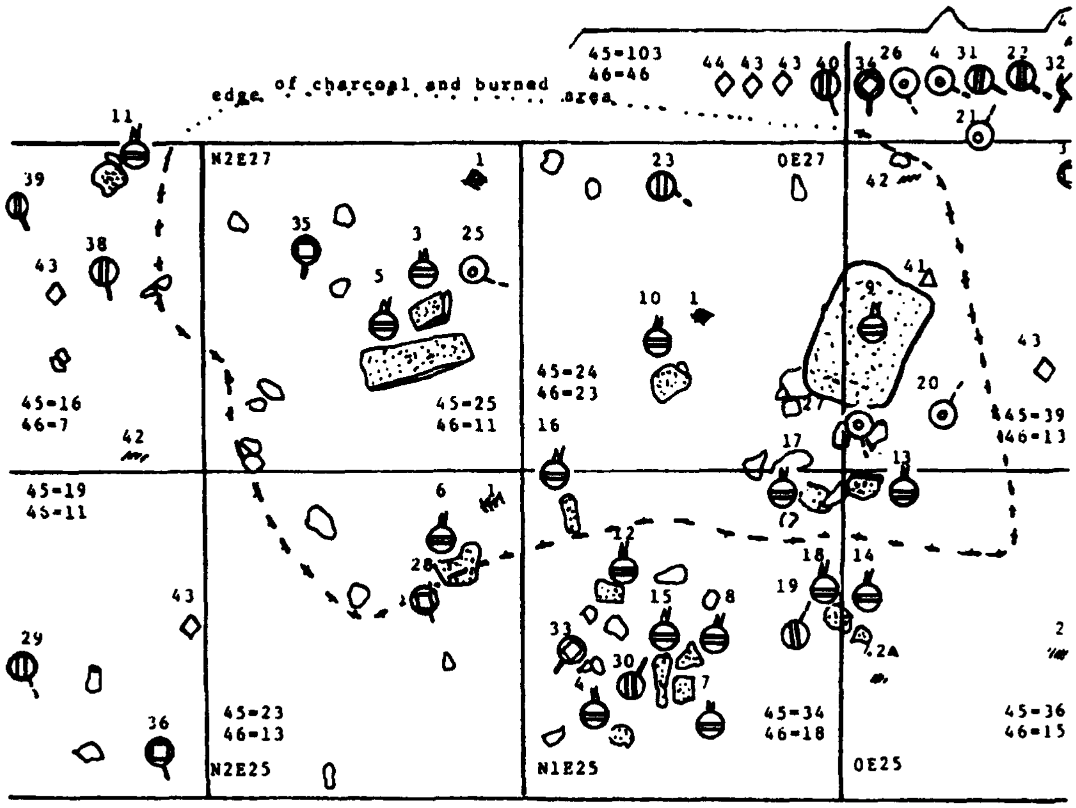
We know equally little about the butchering process, although we did find a core with evidence of chopping and a large ovoid biface with signs of having been scraped against something hard, such as bone from which meat was being removed.

Evidence of flintknapping includes a core, 345 chips, and 161 flakes.

This Hueco fall-winter occupation by a small task force (perhaps winter hunters) reflects a rather different set of activities than those of Hueco occupations in other seasons. It helps fill out our reconstruction of the calendar-round of seasonally scheduled activities. Roughly contemporaneous but very different is feature 7, a few meters to the east.

The Way of Life of Feature 7 and Zone B, East Trench

Feature 7 first was encountered in our 1988 excavation of the east trench, from S1E27 to S1E32, at which time we found a Todsen point under it in lower zone B as well as a cleaver and half-moon biface in the thin (20-30 cm) underlying zone C (see Figure V-16). At that time, we believed feature 7 was a thin (5 cm) charcoal stratum from 0E25.85 to 0E27.05. It had a large unifacial boulder metate lying on it and a Hueco point just along the south edge of the floor. In 1989, hoping to collect charcoal for dating in association with burned clay for archaeomagnetism as well as Hueco cultural material, we troweled off six squares to the north–0E26, 0E27, N1E26, N1E27, N2E26, and N2E27–measuring all artifacts and most ecofacts *in situ*. The charcoal floor and/or the burned strata extended over an area of 2.5 m by 1.5 m, from S0.55E25.72 to 0E27.05 to N1.62E25.58 to N2.12E26.96, but artifacts in upper zone B extended on the east-west axis from S0.6 to N2.75 and from E25 to E27 on the north-south axis–an area of 6-7 m^2. This relatively small area suggests occupation(s) by a fairly small group. For reasons explained below, feature 7 often was referred to as "momma's kitchen." Whether it was occupied repeatedly or only once was difficult to determine, but the large quantity of broken grinding stones suggests a series of occupations. Associated hackberry seeds, as well as the grinding stone that probably was used on corn, suggest all the occupations occurred in late summer-early fall, after



LA5529
Feature: 7
Zone B
Phase: Hueco
C14 Date: A.D. 40± 100

Seasonality: Late Wet Season-Early Fall -- Hackberry Seeds (1), Bird Bone (2)
Major Function: Corn Crop Processing and Possible Roasting Ground Process

Activity *	**Type of Use-Wear**	
Plant Collecting (corn) and Plant Food Preparation		
1 Bifacial Boulder Metate (3), 1 Trough Metate (4), 5 Unifacial Boulder Metates (5, 6, 7, 8, 9)	Back-and-Forth Grinding	Hard
1 Unifacial Slab Metate (10)	Back-and-Forth Grinding	Hard
1 Prismatic Mano (11), 6 2-Handed Plano-Convex Manos (12, 13, 14, 15, 16, 17), 1 Small Rectangular Mano (18)	Back-and-Forth Grinding	Soft
1 Graver (19), 2 Flakes (20, 21)	Cutting	Medium-Soft
2 Large Convex (22, 23), 2 Flakes (24, 25)	Slicing	Medium
2 Flakes (26, 27), 1 Small Flake (28), 1 Large Convex (29)	Shaving	Medium
Butchering		
1 Large Convex Uniface (30)	Cutting	Hard
1 Pebble Side Scraper (31)	Slicing	Hard
2 Small Bifacial Disks (32, 33)	Chopping	Hard
1 Pebble Chopper (34), Pebble Scraper Plane (35)	Scraping	Hard
1 Gouge (36), Small Disk Scraper (37), Small Concave Uniface (38), Large Concave Uniface (39), 1 Flake (40)	Shaving	Hard
Hunting		
Todsen Point (41), 1 Large Canine (42a), 2 Large Mammal Bones (42)		
Animal Collecting and/or Trapping		
Rodent Teeth, 1 Bird, 3 Small Mammals		
Flintknapping		
5 Cores (43)		
1 Blank (44)		
339 Chips (45)		
165 Flakes (46)		

* Numbers in parentheses show location of artifacts and/or ecofacts.

Figure V-16. North Mesa: Feature 7, Late Hueco Phase

the corn harvest, and the date of A.D. 40 ± 100 (UCR2426) suggests these occupations took place late in Hueco phase times.

The floor of feature 7 had fragments of one bifacial boulder metate, one unifacial slab metate, one trough metate, and large fragments of at least five different unifacial boulder metates in association with fragments of six different two-handed plano-convex manos, one two-handed prismatic mano, and a small rectangular mano. All had been ground back and forth and the surface luster and their size suggest they had been used to grind corn kernels. Further, a number of tools and flakes showed use-wear against medium-soft plant materials. Two flakes and two large convex unifaces had been used to slice something medium-soft, while two flakes and a small flake end scraper had shaved similar soft plant materials, and two flakes and a graver had cut medium-soft plant materials. It seems very probable all these tools were used to separate the corn kernels from their cobs for grinding by the manos and metates. Thus a major activity of feature 7 probably was preparing corn for food, which leads to the obvious inference that these Hueco people were growing corn–perhaps in soil watered by the nearby spring in Spring Canyon.

Somewhat to our surprise, we also found almost as many tools with use-wear indicating they were used against something hard, such as hitting bone during the butchering process. The majority of these tools–a flake, a gouge, a small disk uniface, and a large and a small uniface with concave cutting edges–had been used with a shaving motion, while a single pebble side scraper seems to have sliced similar material. A pebble scraper plane and a pebble chopper had been scraped against something hard, like bone; the chopper, as well as two small bifacial disk choppers, had chopped against something hard, and a large convex uniface had cut similar material. It therefore seems that, in addition to preparing corn for eating, these Hueco people were involved in butchering the animals that perhaps had been killed by the Hueco points we uncovered.

Seeming to hint at yet another activity was a slab paint palette that had been ground round and round. When we examined it for traces of paint, however, we found none. Since it occurred in association with hackberry seeds, we suspect it was used to grind up the seeds of wild plants. If so, then another subsistence activity during the summer would have been wild plant collecting.

Evidence of flintknapping is suggested by the many chipped stone tools made of local rhyolite, and the five cores, an ovoid bifacial quarry blank, 165 flakes, and 339 chips–mainly of similar material. Whether the grinding stones were made on the spot is more difficult to determine, although some of the tools with evidence of chopping and cutting something hard could have been used to shape the local boulders or pebbles in Spring Canyon into grinding stones.

Feature 7, which provides a view of the late summer-early fall activities of a Hueco agricultural task force, suggests the activities followed by later occupations at North Mesa.

The Way of Life of Feature 12 and Associated Zone AB, South and East Trenches

Feature 12 was a small rock-filled, burned, and clay-lined basinlike hearth, about 60 cm in diameter, with its center at S10E28.43. It was dug down from zone AB, a thin 5.20-cm layer of light brown dune sand that lay below the humus and above the darker distinctive zone B. Zone AB covered an area about 10 m long from S11E23 to S9E32 and about 3 m wide; it perhaps represents the last definable occupations by the Mesilla phase peoples. The hints of agriculture suggest wet-season visits by a relatively small group in the general period from A.D. 250 to 900.

A few pieces of burned bone of large mammals, as well as Hueco, Padre Gordo, and Hatch points, indicate the people did some hunting. Although a Bajada and an Augustin point were found in this zone, we believe they were dug up from earlier horizons. Two small disk bifaces with evidence of chopping something hard, a cleaver with evidence of adzing hard, a small disk end scraper with evidence of scraping and shaving something hard, two gouges, and a flake with signs of gouging or shaving something hard suggest some of the game was butchered before being roasted on the hearth.

Hinting at collecting plants and preparing them for eating are two flakes with evidence of shaving something medium-hard such as cactus leaves and a large uniface with a convex edge showing signs of scraping and cutting something medium-hard. Evidence that agricultural produce also was prepared for eating comes from a microscopic examination of the three flat slab fragments originally classified as "paint palettes." These slabs show signs (on one or

both surfaces) of grinding back and forth. Use-wear studies suggest the two-sided slab may have been part of a two-handed mano rather than a paint palette, while the other slabs might be parts of metates.

The suggestion of preparing soft plants tends to be confirmed by use-wear studies of a number of chipped stone tools. Two flakes and a large convex uniface had shaved something soft, and two flakes and a small flake end scraper had sliced something soft, perhaps shaving or slicing corn kernels off a cob. A flake also had cut some similar soft material, perhaps leather or meat; the unifacial luster of the tools, however, suggests the polish came from plant material, possibly corn.

Once again, the tools seem to have been made on the spot; we uncovered a core, a pebble hammerstone with one end pecked, 63 flakes, and 110 chips.

Unlike other occupational layers at North Mesa, however, zone AB had 19 sherds, and two brownware sherds were found in feature 12; 14 were slightly polished brown body sherds, but one was of a small-mouthed jar. Sherds of El Paso Brownware and San Francisco Red included two polished brown body sherds, and three rim sherds from different jars. We found no fragments that could be identified as parts of bowls. Only three slightly polished sherds were burned, indicating cooking had been done in them; most of the pottery probably was used for storing food or water.

The sherds are a clear indication that the final occupations at North Mesa occurred during the Mesilla phase, although the activities that were pursued differed little from those of earlier phases at the site.

Summary

Occupations at North Mesa mainly were brief and by small groups, possible mainly task forces. The earlier occupations in zone E (possible pre-Clovis) and in zone D (possibly Clovis) were around a spring in the center of the site and seem to represent hunting and butchering activities. Equally poorly represented were the cultural remains in lower zone C in the same area. Not until Gardner Springs times do we have adequate samples of artifacts and ecofacts that indicate well-defined activities. All the occupations in features 1, 8, and upper zone C seem to have been by small groups during the wet season, and their activities mainly were hunting, trapping, and/or collecting animals and then butchering them, with some plant collecting and flintknapping also taking place. These activities were repeated in the wet- and -dry-season occupations of the following Keystone phase.

Two of the components of the subsequent Fresnal phase–in the spring (feature 2) and wet (feature 6) seasons–show more emphasis on plant collecting and preparation, while the possible winter occupation of feature 9 continues the older pattern. The final Archaic occupations of the Hueco phase continue the trend, with the addition of preparing agricultural produce–that is, grinding corn–an activity that continued into the final occupation(s) associated with feature 12 of the Mesilla phase, A.D. 250-900.

All in all, North Mesa, with its wet- and dry-season occupations, greatly supplemented the Archaic data we had from Tornillo with its summer occupations and Todsen with its predominantly spring occupations.

Section 4

Summary of the Contextual Evidence

The preceding pages are an attempt at reconstructing the way of life represented by a long series of occupations in the many stratigraphic zones of three excavated sites–Todsen, Tornillo, and North Mesa. Our knowledge of the activities carried out during the occupations is uneven, and the definition of some of the sequential phases is extremely poor, particularly the earliest occupations at North Mesa–the possible pre-Clovis occupation from zone E and the possible Clovis occupation from zone D. Further, the early occupations, perhaps of Folsom and Angostura times, represented in lower zone C of the same site are even less well known.

Almost as poorly known are the later prehistoric occupations when ceramics were in use. Least known is zone C of Todsen Cave, which bears obsidian hydration dates of A.D. 1625 and 1675 and seems to pertain to an Apache occupation or activities associated with a child burial. These activities included hunting and collecting and/or trapping animals, butchering them, cooking them in pots, and flintknapping to make the stone tools needed for the various activities. Since little information exists about this horizon from other excavations in the region, even our meager data from Todsen Cave represent new information and define problems to be solved by further investigation.

Somewhat more complete is our knowledge of the way of life of the other Ceramic horizons–the Mesilla, Doña Ana, and El Paso phases–that have been well-defined by many local excavations. The components we excavated, however, represented the way of life Puebloid peoples followed on brief forays away from their homes, giving us but a glimpse of their total culture and way of life. Most poorly represented was the Doña Ana phase, which occurred only in zone D1 of Todsen Cave. The El Paso phase was represented by zone D in this same shelter. Best represented was the Mesilla phase, components of which occurred in zone D2 at Todsen, feature 12 and zone AB at North Mesa, and the poorly defined zone A of Tornillo. All these occupations represent relatively few activities–hunting, collecting, growing crops, preparing food, flintknapping, string and textile manufacturing, and burying children–and are but a small part of the total cultural activities.

Very different from this incomplete picture of the Ceramic phase way of life in the Jornada region are the Archaic phases at our three excavations. Although limited, our excavated artifact materials form the basis for the first preliminary definition of the Archaic phases of the Jornada, namely, Gardner Springs, Keystone, Fresnal, and Hueco.

The Gardner Springs way of life is the poorest represented; its four components reflect a spring occupation or occupations in zone K1 of Todsen Cave and three summer/wet-season occupations at North Mesa (features 1 and 8 and upper zone C of the central trench). These occupations represent but half the scheduled activities of the annual calendar-round, although an unanalyzed possible fall occupation from Fresnal hints that the people followed much the same way of life for the rest of the year. All occupations seem to have been brief stays by microbands or task force groups. At all seasons hunting, butchering, flintknapping of tools as needed, and roasting of bark, plant leaves, and meat were major activities. Animal collecting and/or trapping was a minor activity in all but one summer occupation (feature 8), when it became a major one. Grinding seeds was a minor activity in the one spring and summer occupation and a major one in another summer occupation; no grinding may have been done in the dry winter season when no seeds reached fruition. Activities such as working bone, wood, or ground stone, and manufacturing string and textiles were represented poorly but probably existed.

The following Keystone phase (4300-2600 B.C.) is slightly better represented, although it had only three brief occupations by small groups–zone K of Todsen, which occurred during the spring; feature 4 of North Mesa, a summer stay; and feature 11 of North Mesa, a winter occupation. Hunting and butchering continued to be major activities. Although animal collecting and/or trapping had become more important, plant collecting still occurred only in the spring and summer; seed grinding was a major activity in the former season. Flintknapping continued to be important, but only hints exist of working bone, wood, and skins, making string, and manufacturing textiles.

Not until Fresnal times (2600-900 B.C.) does adequate information appear on these activities. We uncovered three spring components (feature 2 of North Mesa, zone J1 of Todsen, and zones F-J of Todsen), three summer/wet-season occupations (zones C and B of Tornillo and feature 6 of North Mesa), a single fall occupation (zone D of Tornillo),

and one winter stay (feature 9 of North Mesa). Most occupations still were by microbands and/or task forces; even the spring-summer occupation of zones F-J of Todsen, which might be interpreted as the stay of a macroband, could have been multiple occupations by microbands.

Noticeable changes, however, occurred in the subsistence system during Fresnal times. Only in the winter was hunting still a major activity; small animal collecting and/or trapping was more important in most seasons. Butchering animals and roasting their meat still were major activities. The most important subsistence activity in all seasons but winter, however, seemed to be plant collecting, of both seeds and leaves. Supplementing it in the wet season was incipient agriculture based on corn and cucurbits. Evidence of grinding plants and their seeds was abundant in the form of small manos and metates and the now less numerous muller and milling stones. All the foods were cooked in a variety of ways over a hearth or roasted on boulder-filled or slab-lined pits.

Flintknapping continued during Fresnal times at many occupations, but some task-oriented stays, such as those at Tornillo, replaced flintknapping with the making of string and carrying loops from cut yucca strands during the summer and fall occupations. In these seasons and in the spring some weaving and woodworking were undertaken, while bones and skins were worked during the spring occupations, and a burial was made at that time. The Fresnal materials thus not only show evidence of more activities, but also seasonal scheduling.

These trends continued into Hueco times. Occupations mainly were by small groups and lasted for brief periods. The Todsen occupations in zones E, E1, and E2–and πJ, their downslope equivalent–seem to have occurred during the spring, while summer/wet-season occupations occurred in features 5, 3, 10, and 7 of North Mesa as well as the floor of zone A1 at Tornillo. Although poorly represented, dry-season occupations occurred in the upper part of zone B of the central excavation at North Mesa.

Hunting of large mammals apparently continued to decrease except in the winter season, while fishing and collecting and/or trapping small mammals became more important. Butchering and roasting meat on hot rocks continued to be important activities. However, use-wear studies, in conjunction with C13/12 and N15/14 analyses, indicate the collecting of seed, roots, and leaves was a major subsistence activity in all seasons but winter. Also, the summer occupations show evidence of increasing incipient agriculture, mainly based on corn, although beans, amaranth, and cucurbits also may have been grown. Grinding plant foods increased in the spring and summer occupations and more of it involved corn.

To flintknapping was added the making of ground stone tools in the spring and summer seasons. In this season string, carrying loops, baskets, and textiles also were made, while skins were worked in both the spring and winter. Evidence of woodworking occurred mainly in the summer and boneworking in the spring, along with burials and ceremonies.

When put together with data from Fresnal, La Cueva, and Upham's Organ Mountain sites, the information from the excavations of Todsen, North Mesa, and Tornillo allows us to create a preliminary reconstruction of the way of life followed by people in the Jornada region during the Archaic period. These data can be used to test our hypothesis about the origin of agriculture and village life in the Southwest, the topic considered in our final chapter.

Chapter VI

CONCLUSIONS

We now have presented our analyses of the archaeological and ecological data collected in five seasons (1985-1989) at three sites–Tornillo, Todsen, and North Mesa–in the region of Las Cruces in south-central New Mexico. In this final chapter we shall attempt to reach some preliminary conclusions oriented to the problems of the origins of prehistoric agriculture in the Southwest, which we attempted to define in Chapter I.

The data that are relevant to the solution of the problem of the origin of agriculture in the Jornada region also have bearing on the whole Southwest. The Paleo-Indian remains we found in zones E and D of North Mesa and perhaps in zones M and N of Todsen, however, had little direct bearing on the beginning of the use of cultigens many millennia later (see Figure VI-1). In fact, the earliest archaeological phases relevant to this problem began in the Archaic only after people had shifted their main subsistence pattern from the hunting of big game to the collecting of animals and, more importantly, plants, for the latter are what became domesticated, a step that led to village agriculture. Before reconsidering our initial hypotheses and considering how the new data tested or modified them, we first need to summarize the Archaic period (MacNeish, 1989).

Summary of Archaic Phases

Gardner Springs Phase: 6000 ± 500–4300 ± 300 B.C.

The Gardner Springs phase is the most poorly understood of our Archaic phases. Not only is our knowledge of the Gardner Springs subsistence and technology limited, but hints about the people's religion and social organization, even from ethnographic analogy, are almost nonexistent. Gardner Springs has only about 21 components represented by slightly less than 100 artifacts and about 1,500 pieces of debitage from excavation (see Figure VI-2). Any questions about its origins must be speculative at most, particularly since its possible predecessors in the region–pre-Clovis, Clovis, Folsom, and perhaps Angostura–are even less well known. Did Gardner Springs develop from these predecessors in the region or is it an invader into the region? I tend to follow Cynthia Irwin-Williams's hypothesis (Irwin-Williams 1979) that the complex was intrusive into the region from the west.

Gardner Springs seems to have more similarities in terms of choppers, grinding stones, and Jay-like points to the earlier Sulphur Spring (8400-6100 B.C.) of southern Arizona (Waters 1986) and the San Dieguito culture (Haury 1950) than it has to any of the late local "big game hunters."

In terms of population and settlement patterns, the speculation that the Gardner Springs people were "Desert Culture" foragers fits very well with the limited site survey and seasonal data that we have (Jennings 1964). Most (12) of the sites were on the desert floor and/or around the playas there, although two were in mountains with oak-pine vegetation. One of these, Fresnal Shelter, could well be a fall occupation, while the occupations on the alluvial slopes at Peña Blanca and the one in the lower Bajada could be summer occupations. The three occupations in the upper Bajada at North Mesa and zone K1 of Todsen seem to be summer and spring occupations respectively.

Except for a couple of sites on the desert floor, all occupations were small, either by microbands or task forces; even the larger ones located in the playa could have been multiple microband occupations rather than stays by a macroband. Our limited data seem to indicate macrobands wintered on the desert floor and/or playa areas, but with the coming of spring some moved out to at least the lower alluvial slopes and lower Bajada ecozones and then moved further to occupy most ecozones in the summers. In the fall they visited high elevations to collect acorns and pinyon nuts, then returned to the desert floor-playa zones as the season got colder. Task-force visitations seem to have occurred mainly in the summer months for specialized collecting, making stone-filled roasting pits, or flintknapping; the lack of storage pits seems to indicate the people were often on the move. Their way of life was a simple, scheduled seasonal-round settlement pattern organized around a few very small groups.

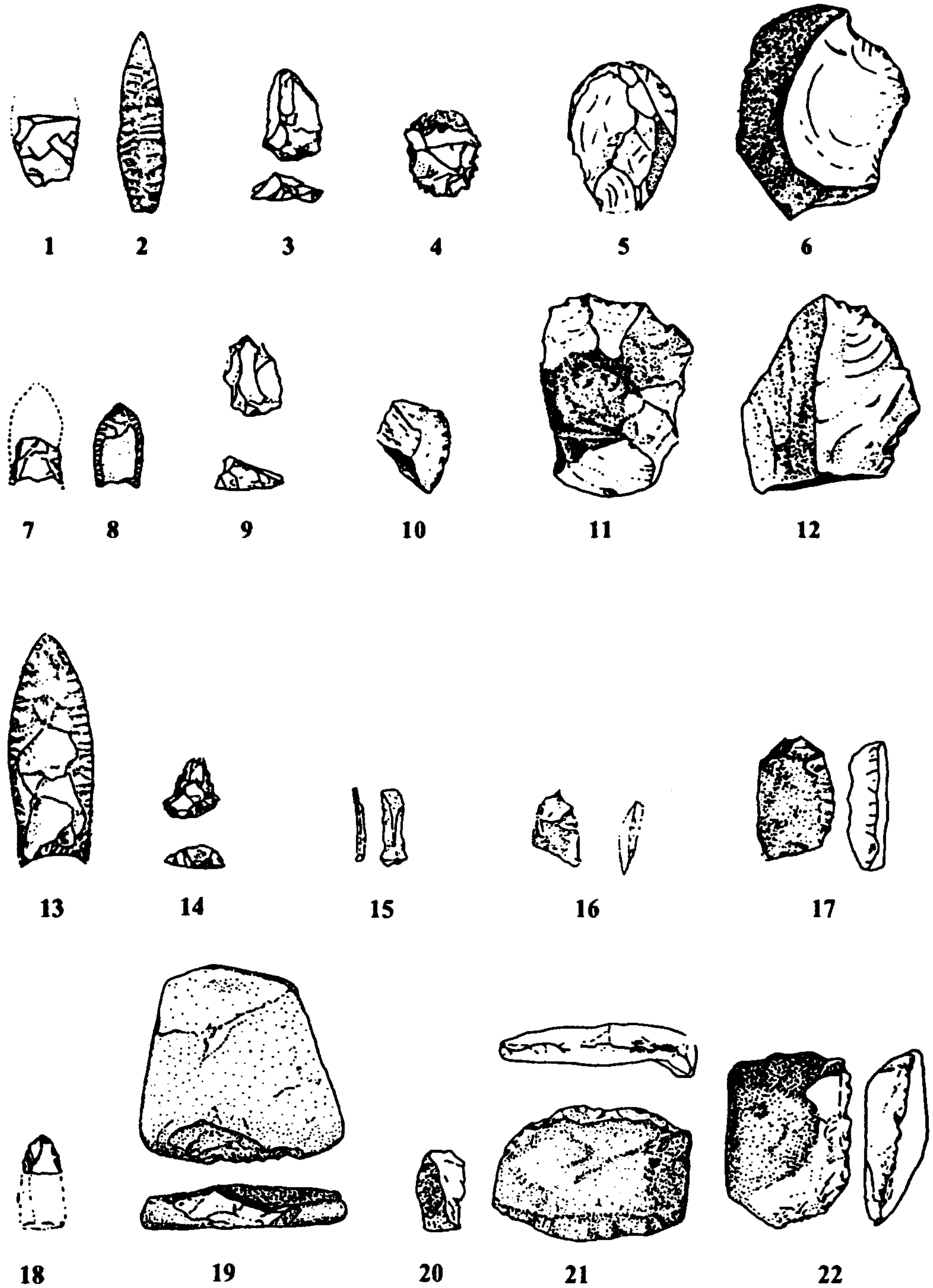


Figure VI-1. The Tentative Paleo-Indian Complexes Before 6000 B.C. (most recent at top)

ANGOSTURA: 1 and 2 Angostura Points, 3 Snub-nosed End Scraper, 4 Denticulate, 5–Pebble Chopper, 6–Large Convex Side Scraper.
FOLSOM: 7 and 8–Folsom Points, 9–Snubnosed End Scraper, 10–Small Convex Scraper, 11–Pebble Chopper, 12–Large Convex Side Scraper.
CLOVIS: 13–Clovis Point, 14–Sunbnosed End Scraper, 15–Blade, 16–Graver, 17–Pebble Side Scraper-chopper.
PRE-CLOVIS: 18–Ayacucho Point, 19–Pebble End Scraper, 20–Blade, 21-Pebble Cleaver, 22–Pebble Side Scraper-chopper.

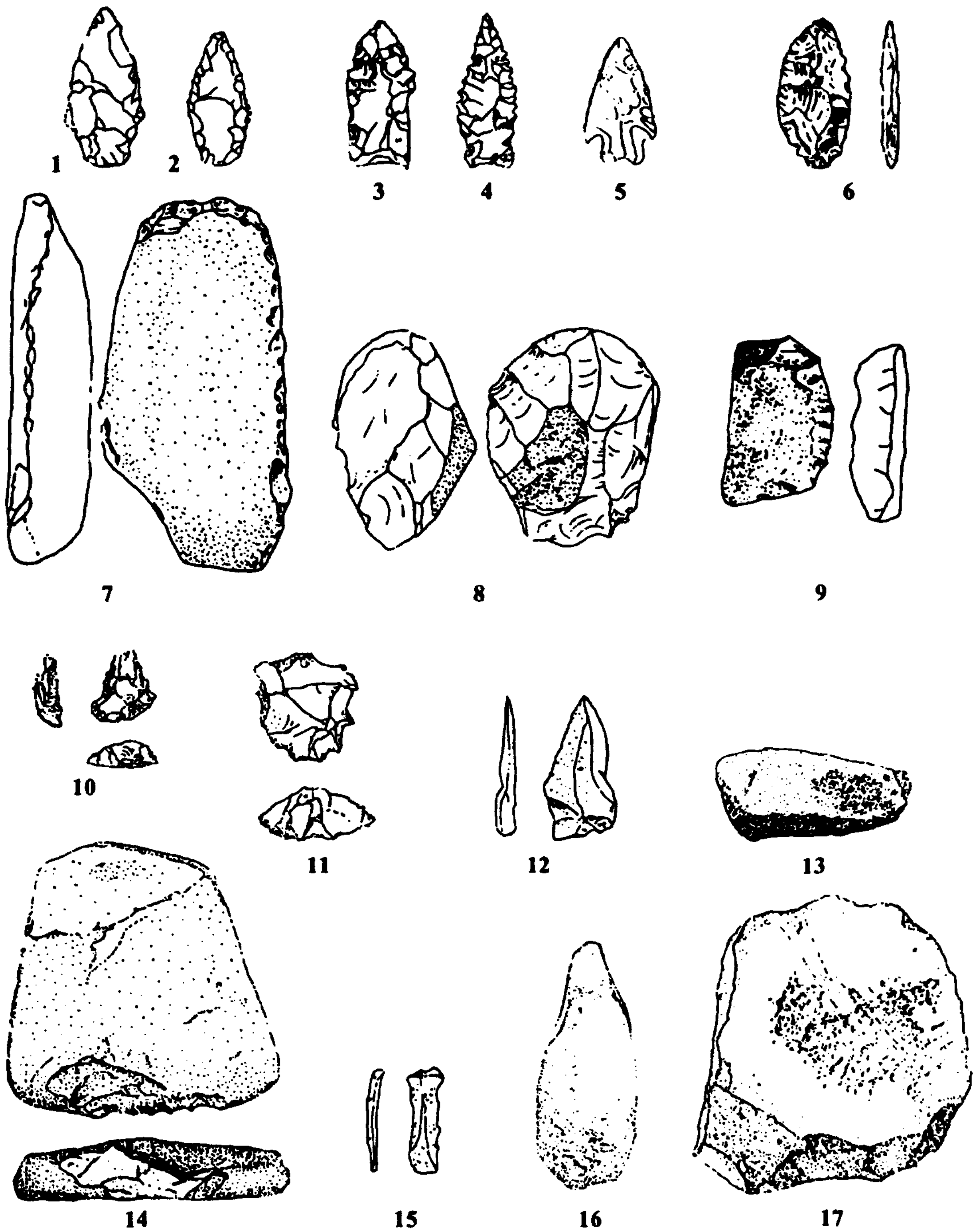


Figure VI-2. Gardner Springs Artifact Types

PROJECTILE POINTS: 1 and 2–Jay, 3 and 4–Bajada, Baker.
OTHER ARTIFACTS: 6–Half-moon Side Blade, 7–Pebble Cleaver, 8–Pebble Chopper, 9–Flat Pebble Unifacial Chopper, 10–Snub-nosed End Scraper, 11–Denticulate, 12–Flake Graver, 13–Pebble Muller, 14–Pebble End Scraper, 15–Crude Blade, 16–Pebble Pestle, 17–Boulder Anvil-Milling Stone.

In terms of subsistence these Archaic people probably were foragers engaged in hunting, animal collecting and/or trapping, and plant collecting. We cannot verify this idea, however, because we lack preserved plant remains, coprolites, and skeletons to analyze for C13/12 or N15/14. The few animal bones found in Todsen Cave suggest the people did more hunting of deer and antelope than collecting or trapping of small animals, such as jackrabbits; and the (atlatl dart) points we found–Abasolo, Jay-like, and Bajada–tend to confirm this hypothesis. Pestles, mortars, mullers, and milling stones suggest the people collected seeds, perhaps on a seasonal basis, and broke or coarsely ground them. Numerous choppers and butchering tools, however, suggest animal meat was more important than plant foods; the few boulder-filled roasting pits could have been used to cook or roast both kinds of food.

Use-wear analysis done on a few of the snub-nosed end scrapers suggests the people scraped skins for clothing and perhaps footwear. Data for the contemporaneous occupations of nearby Hermit's Cave hint that these people already may have had (square-toed) sandals and done twine weaving with agave string or yarn to make clothing and blankets (Ferdon 1946). Comparative data suggest twined baskets, nets, bags, and other textiles were used, but as yet we have found none at our stratified sites (Jennings 1964).

Another industry indicated by use-wear studies and the presence of denticulates is woodworking; Hermit's Cave had a grooved club or shaft straightener in its lower level (Ferdon 1946). Many of the choppers also could have been used for this activity. Undoubtedly the atlatl (dart) shafts and various handles were of worked wood.

Some of the same tools as well as prismatic blades seem to have been used to work bone; we found some polished and cut bone and/or antler in the refuse of Todsen Cave. However, as with the textiles and wood tools, we found few bone tools in our excavations.

Keystone Phase 4300 ± 300–2600 ± 200 B.C.

Compared with Gardner Springs, Keystone (see Figure VI-3) is better dated (eight dates compared with two), has more survey sites (23 compared to 12), and a few more excavated components (13 as against 9). Keystone also has a few pits, some of them much larger than those at Gardner Springs, and there were more kinds of roasting pits. Keystone also has more artifacts (more than 150 as against about 100) and more debitage (about 2,000 fragments as against less than 1,500 for Gardner Springs). Further, there is a possible pithouse from the Keystone site along the Rio Grande just north of El Paso (O'Laughlin 1980).

Our artifact type charts, however, indicate considerable continuity from Gardner Springs, and we assume it is the ancestor of Keystone, even though influences still are coming in from the west as well as up from the south in Mexico. Speculations about why Gardner Springs developed into Keystone consider the further development of the desert seasonal scheduled subsistence system, possibly population pressure, climatic change due to the onset of the post-glacial optimum, further diminution of big game, and other factors; perhaps all these factors worked in some sort of positive feedback system.

Most of the 36 Keystone components (two of which are radiocarbon dated) still seem to be brief seasonal microband encampments with a few task-force sites at which about the same kind of activities were performed as at Gardner Springs. Keystone, however, has five larger sites; while they might be mainly multiple microband occupations, some may be macroband encampments. Pithouse 2 of site 33 at the Keystone site tends to confirm this opinion; it may belong to a winter occupation, perhaps by three or four microbands living in similar houses, forming a macroband or base camp type of settlement (O'Laughlin 1980). A study of the seasonality of the sites, however, suggests a similar calendar-round pattern, with people wintering on desert floors or at pithouse base camps along the Rio Grande and then spreading out to other microenvironments in the other seasons of the year, to return to their base camps with the return of winter.

The settlement pattern and the subsistence system seem to have changed only a little from Gardner Springs times. However, we lack perishable plant remains, feces, and an adequate sample of skeletons to analyze isotopically for C13/12 or N15/14. One clavicle from the backfill of Chavez Cave may be of this horizon; it gave a C13/-12 reading of about -18, while the N15/14 reading was about +7. These figures suggest a diet containing considerable plant foods and limited meat from animals, the reverse of what we postulated for Gardner Springs.

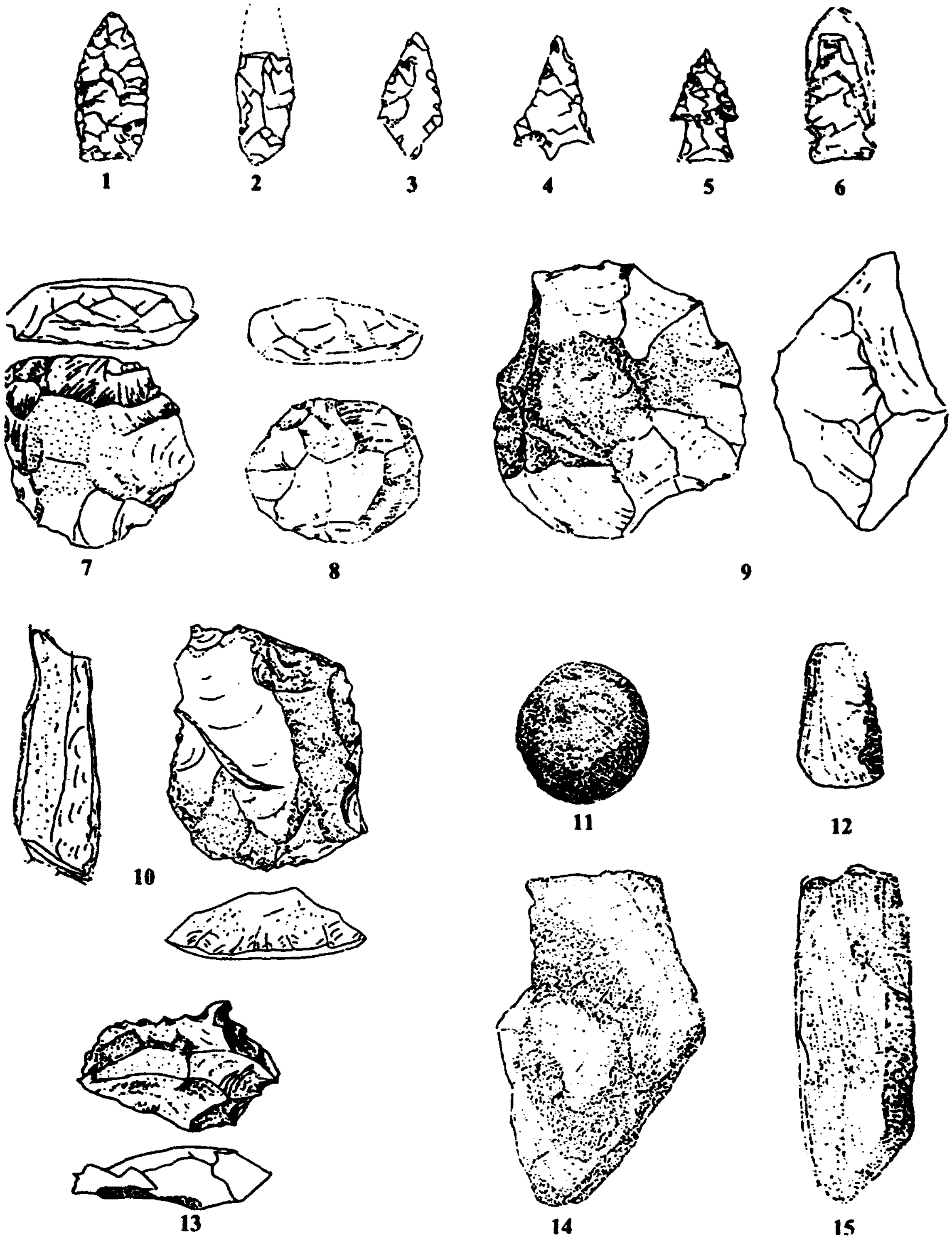


Figure VI-3. Keystone Artifact Types

PROJECTILE POINTS: 1–Bat Cave, 2–Lerma, 3–Pelona, 4–Gypsum-Almagre, 5–Amargosa-Pinto, 6–Todsen. OTHER ARTIFACTS: 7 and 8–Large Discoidal Choppers, 9–Pebble Chopper, 10–Denticulated Scraper Plane, 11–Discoidal Muller, 12–Pebble Mano, 13–Denticulate Saw, 14–Pebble Milling Stone, 15–Slab Metate.

The artifact complex, particularly the increasing amount of ground stone, tends to confirm such a hypothesis. In addition to pebble mullers and anvil milling stones known earlier, Keystone sites have unifacial milling stones, well-made discoidal mullers, and narrow unifacial slab metates. These tools not only suggest that plant grinding was increasing, but that new types of seeds were being ground to make finer flour. Further, the occurrence of scraper planes and the use-wear on unifaces suggest leafy plants (opuntia, agave, and lechuguilla leaves) were being scraped to make them palatable. Supporting this belief is the presence of more and larger pits full of fire-cracked boulders or slabs, which suggests more roasting of plant foods.

Of course, these pits also could have been used to roast meat. Although our sample from zone K of Todsen Cave is not large, it does show an increase in small mammals (jackrabbits), and a decrease in large ones (deer and antelope). Agave string slip knots hint that these smaller animals were trapped by snares and spring traps. Larger animals probably were hunted down with atlatl-propelled darts tipped with Bat Cave, Lerma, Pelona, Gypsum-Almagre, Todsen, and Amargosa-Pinto types of projectile points. Keystone thus reveals a subtle shift toward a more efficient desert foraging subsistence system as well as a possible exploitation of more desert plants from more ecozones.

Although the styles and functions of the tools differ, the basic technology–flintknapping, working of wood and bone–is much the same according to our use-wear studies. Skin or hide work, however, seems to have diminished noticeably, while the ground and pecked stone industry has increased. Use-wear studies and looters' collections from local caves both provide hints that the Keystone textile industry also differs from that of Gardner Springs. Square-toed sandals probably were in use, and coiled baskets (often with interlocking or noninterlocking stitches) probably increased as twined ones decreased. Mats also may have been woven, as were twined and coiled bags.

Evidence on social organization, although woefully inadequate, hints that some sort of exogamous band type may have been in existence by Keystone times, and a bone bead hints that changes were occurring in the artistic and ceremonial realm. These new features are better documented and more apparent in the following Fresnal phase.

Fresnal Phase: 2600 ± 200–900 ± 150 B.C.

The Fresnal phase (see Figure VI-4) seems to represent a time of major change in the Archaic, but whether this is because our sample is much larger–73 components with more than 400 artifacts and 4,000 bits of debitage as well as burials and sites with preservation–or because fundamental changes occurred, has been a subject of some debate (Wills 1988). I believe the Fresnal phase marks a significant change. At this time in other parts of the Southwest, major shifts were occurring–in San Jose in the Oshara tradition (Irwin-Williams 1973) and in Chiricahua of the Cochise tradition.

Artifact overlap suggests Fresnal developed out of Keystone. The question that occurs is, what caused the fundamental changes? Certainly the arrival of domesticates, corn and pumpkins *(Cucurbita pepo)* from Mesoamerica, perhaps accompanied by various cosmological concepts, could have been a factor for change. Major changes also occurred in population and settlement patterns at this time, which marks the end of the post-glacial optimum and the onslaught of the amenable medithermal with its less arid conditions. Which of these factors or combination of factors, perhaps operating as a positive feedback system, brought about the changes leading to Fresnal, we do not completely understand, but change did take place.

The most obvious changes are in the settlement patterns and related population increases. Not only do we have more survey sites (51), but we have about 20 excavated components that are noticeably different from those of Keystone. Although more than 20 of the survey sites are task force sites, an equal number are occupations by much larger groups–macrobands, pithouse base camps, or some multiple-use microband sites. These larger sites are in the riverine environment of the Rio Grande or the desert floor-playa areas and may be both winter and summer occupations (perhaps occasionally both). Seasonal forays–mainly task force encampments or microband occupations–radiate out from the larger sites at all seasons and serve a variety of purposes. The Fresnal phase thus marks a shift from the old calendar-round system to a base camp radial system. The larger number of sites also suggests the population may have tripled.

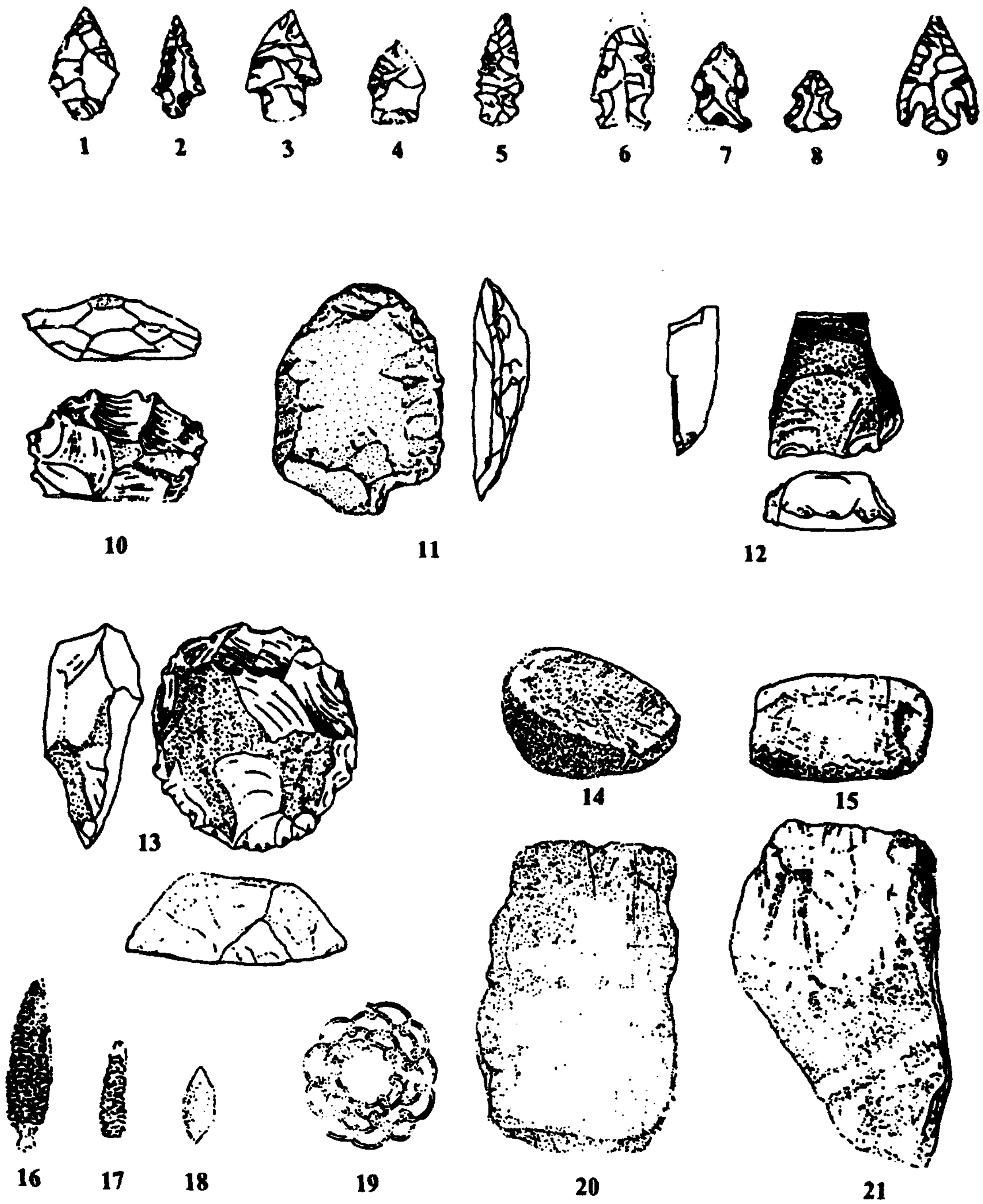


Figure VI-4. Fresnal Artifact Types

PROJECTILE POINTS: 1–Pelona, 2–Augustin, 3–Fresnal, 4–San Jose, 5–Armijo, 6–Todsen, 7–Chiricahua, 8–La Cueva, 9–Shumla-like.
OTHER ARTIFACTS: 10–Large Discoidal Chopper, 11–Flake Chopper, 12–Gouge, 13–Pebble Scraper Plane, 14–Wedge Mano, 15–Small Rectangular Mano, 19–Coiled Net, 20–Rockered Metate, 21–Boulder Unifacial and Bifacial Metates.
PLANT REMAINS: 16–Chapalote, 17–Proto-Maiz de Ocho, 18–Pumpkin Seed.

Closely connected with these changes seem to be shifts in the subsistence system, although the Fresnal people still followed basically a seasonally scheduled foraging subsistence. As evidence of this shift we have a few feces, and Fresnal, Tornillo, and some other Organ Mountain sites had preserved plant remains; we also have analyzed two or possibly three skeletons for proportions of C13/12 and N15/14, as well as bones and artifacts reflecting subsistence practices. All these remains suggest the Fresnal people scheduled their collecting of a wide variety of plants by forays into different ecozones in different seasons. Even the incipient agriculture of corn and squash was a sort of wet-season plant supplement to their plant collecting rather than a main item of their diet. Both collecting and planting were sufficiently successful, however, so that people began to store their surpluses in pits for the lean winter seasons ahead. In addition, they used bags, baskets, carry loops, and nets to bring the plant foods home, where they were prepared in a variety of ways. Some seeds were finely ground on metates; others were coarse ground on mortars or milling stones, and some were cracked in mortars. Some seeds and leaves (and meat) were roasted in a wider variety of roasting pits–boulder-filled pits, slab-lined ones, burnt rock middens, and the like. People were learning to exploit more and more of the plant kingdom in a variety of ways in a number of ecozones. They even selected the Chapalote corn they received from Mexico, so that by the end of the period (at least 1225 B.C.) they had developed proto-Maiz de Ocho, which was drought resistant and adapted to their unreliable cycles of rainfall (Upham et al. 1987).

The Fresnal people of course continued to have some meat in their diet; the majority probably from small mammals (mainly jackrabbits) that they collected, killed in drives, brought down with rabbit sticks, or caught in spring traps or net snares. A few deer and antelope bones attest to hunting using a wide variety of dartlike spear point types–Todsen, Pelona, Augustin, Chiricahua, La Cueva, San Jose, Armijo, Fresnal, Nogales, Maljamar, and others. In fact, the number and variety of styles of points seem way out of proportion to the amount of big game animal meat in the people's diet.

Flintknapping, woodworking, and boneworking industries stayed about the same, but, as during Keystone, the ground stone industry increased and skinworking decreased. In addition to evidence of a flourishing textile industry, we know Fresnal people made square-toed and fishtail two-warp sandals, twined cloth and nets, and wove several kinds of baskets, mainly coiled in a variety of ways. Fresnal people also made many kinds of string (of agave, lechuguilla and other substances) and a wide variety of knots–overhand, slip, square, sheep bend, and others.

The Fresnal culture seemingly shows more similarities to and possibly influences from more areas. San Jose, Amargosa-Pinto, and Armijo points indicate Oshara connections; Augustin, Pelona, and Chiricahua points hint at Chiricahua connections to the west; and Fresnal sandals and baskets are similar to those made in the Big Bend area.

Ceremonial or artistic objects include tubular bone beads (plain, notched, or painted), beads of olivella shell imported from the Pacific Coast, and wooden objects, sometimes painted. Also, there are hints of pictographs featuring circles, zigzag lines, snakes, stick "dancing" figures, and other animals. These artifacts give us the beginnings of understandings about the people's social organization, shamanistic rituals, religious organizations, and cosmology. Even better known is the final Archaic phase–Hueco.

Hueco Phase: 900 ± 150 B.C.–A.D. 200 ± 100

While we only have about 25 excavated Hueco components, we do have 87 surface sites, more than 800 artifacts and about 9,000 ecofacts, as well as many (25) chronometric data. Our Hueco sample (see Figure VI-5) thus is the best defined of any of our Archaic phases.

Continuity of artifact types suggests Hueco developed out of Fresnal, although some culture changes occurred for reasons that remain speculative. Further, the local development of new races of corn–Maiz de Ocho (Basketmaker) and Pima-Papago–could have resulted in increased food production, which could be connected with the growing population of Hueco peoples. Widespread external contacts could have inclined these people toward change. Certainly the importation of beans and perhaps amaranth from Mexico, as well as ceremonial concepts that were developing in the contemporaneous Formative of Mesoamerica, could have been factors for change. The changes, which had started in Fresnal, reached fruition with the late Mesilla phase, when village agriculture finally developed.

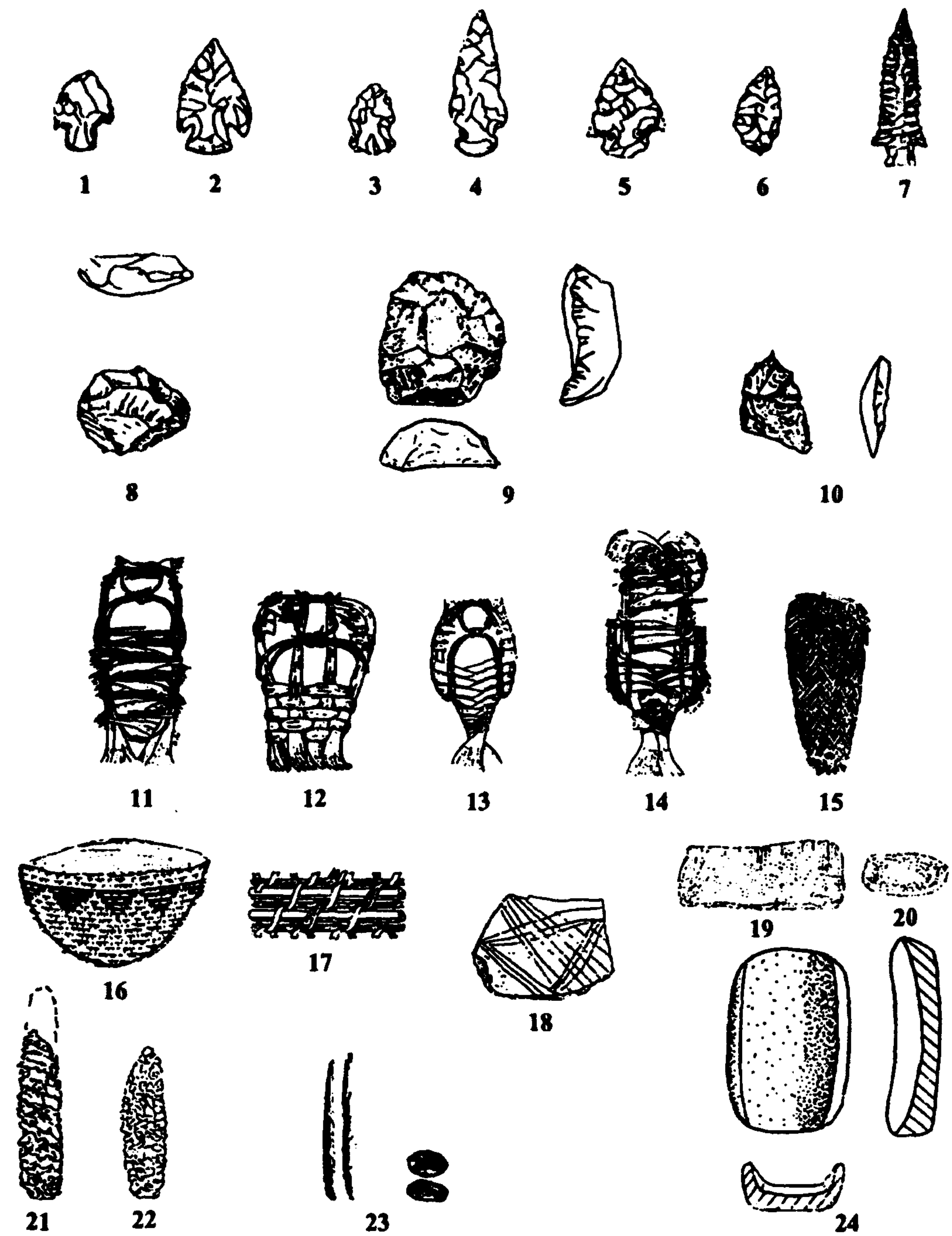


Figure VI-5. Hueco Artifact Types

PROJECTILE POINTS: 1–Hatch, 2–Hueco, 3–San Pedro Small, 4–San Pedro Large, 5–En Medio, 6–Padre Gordo, 7–Pendejo.
OTHER ARTIFACTS: 8–Small Disk Chopper, 9–Small Disk Scraper, 10–Small Pointed Flake,
18–Paint Palette, 19–Two-handed Mano, 20–One-handed Mano, 24–Trough Metate.
SANDALS AND BASKETS: 11–Cosgrove Type 1, 12–Type 2, 13–Type 4, 14–Type 5,
15–Type 6; 16 and 17–Two-rod Coiled Baskets.

The continuity of Fresnal trends is very apparent in the realm of population and settlement patterns during the Hueco phase. Most of our 26 excavated Hueco components are seasonal microband or task force occupations, but Carmichael (1986) netted 87 Hueco sites in his survey. The sites that are obvious task force occupations increased greatly (from 16 to 43); however, it is difficult to distinguish archaeologically between family microband occupations exploiting a single seasonal resource for a short period and occupation by one or a few individuals who do a special activity for a few hours or days. The increase in task force sites during the Hueco phase is often accompanied by new and different types of rock-filled roasting pits, representing the new tasks performed in new ecozones in various seasons.

Macroband base camp sites also increased and often were bigger and occupied for longer periods than were Fresnal sites, and probably had more pithouses. We cannot determine the latter until some of the large Hueco open sites are excavated adequately. Unlike earlier periods, when base camp sites were limited to one or two areas, the Hueco base camp sites occurred in most of our ecozones, a trend that seems to continue into Mesilla times, when the base camps gradually developed into year-round pithouse hamlets, by the end of the phase becoming villages of sedentary people practicing full-time agriculture. Hueco represents the middle step in this development.

Evidence of the Hueco subsistence system comes from analysis of feces, sites with preserved refuse, and at least three skeletons. These studies suggest further increases in the seasonally scheduled collecting of more edible plants in more ecozones, as well as increased seasonal planting of more domesticates–Chapalote, proto-Maiz de Ocho, Maiz de Ocho, and Pima-Papago corn, pumpkins, common beans, and perhaps amaranth–as a supplement to plant collecting. Also increasing were the number and variety of food storage facilities (suggesting longer occupations in one spot), roasting pits, grinding stones (including heavy manos for grinding corn), and carrying loops, nets, bags, and baskets for collecting an increasing variety of plants.

Analysis suggests a decrease in the consumption of meat and related subsistence activities. We found fewer deer, antelope, and large animal bones even though there were a large number of dart points–Armijo, Hueco, San Pedro large, San Pedro small, Hatch, En Medio, and Padre Gordo. The last three of these are small enough to be arrow points, although we lack real proof of use. Bones of small mammals (mainly jackrabbits) are more numerous than those of big animals; these small animals probably were collected, hunted, and trapped. Additions to the diet are fish and turtle, suggesting an exploitation of the Rio Grande, a trend that continued to increase in El Paso times and is reflected in increasing N15/14 values.

Although some of the technology connected with subsistence activities changed, in the main the flintknapping, woodworking, and boneworking activities remained the same. Hideworking decreased while ground stone activity increased, as did the textile industry. Sandal types included four-warp scuffer-toed, two-warp scuffer-toed, fishtailed, fuller length heeled, and twilled scuffer-toed. In addition to interlocking stitch baskets are a few split stitch baskets.

During Hueco times ceremonial objects, such as notched beads, shell beads, painted sticks, and pictographs, increased and we have hints of some sort of exogamous band social organization. Pictographs hint of shamanistic ceremonial leaders. An adolescent burial with a sash of 276 notched bone beads (burial 4 at Todsen) and other burials without grave goods suggest social differentiations. The kinds and variety of pictographs may be increasing; more insects, serpents, birds, and animals with possible ceremonial or supernatural connections appear.

Our research into the Chihuahua Archaic therefore indicates a slow evolution through the Archaic and into the Early Ceramic (pithouse) Mesilla period, with real agriculture and village life not being attained until the time of the Doña Ana and/or El Paso phases, A.D. 900-1300. This pattern is unique for the development of village agriculture. We have just enough glimmerings of the process to allow us to speculate about why it happened and to formulate a hypothesis to be tested by data comparing the Chihuahua tradition with other sequences in the Southwest, as well as with relevant developments anywhere, at any time (MacNeish 1992).

Theoretical Considerations

In setting up our hypothesis, we need to consider what may be the necessary conditions or prerequisites that led to the Jornada cultural development, framing these conditions so that they can be applied anywhere.

Development in the Jornada Region

Obvious prerequisites for development of agriculture in the Jornada are environmental factors. The few domesticable plants existing in the Southwest, and the area's connections (albeit casual) with Mesoamerica–a center where much domestication occurred earlier–make the Southwest an area where the development of agriculture occurred secondarily (MacNeish 1967).

Furthermore, the Jornada region is a desert region with great seasonality and extreme climatic fluctuations that result in unpredictable cycles, factors that made the development of agriculture difficult. Moreover, the various ecozones of the region could not be exploited from a single base, a condition that promoted seasonal scheduling and a type of nomadism that favored collecting over sedentary agriculture. On the other hand, the fact that the Rio Grande created a lush natural ecozone that was not circumscribed meant it was easier for people to succeed as efficient foragers than successful farmers.

Clearly, the necessary conditions were not encouraging for the development of village agriculture. What brought that agriculture into being, albeit very slowly indeed, was a series of unique sufficient conditions or triggering causes. Where triggering conditions did not occur–in parts of adjacent Texas, Coahuila, and the Big Bend area–village agriculture failed to develop in prehistoric times. We might say the Jornada peoples were reluctantly dragged into a village agricultural way of life from their successful foraging existence.

What factors brought about the changes? To understand them, we must analyze each of four phases, for the causes changed over time, although the environmental factors often remained the same (see Figure VI-6).

Phase 1: Hunters to Foragers. Our story starts with the end of the Pleistocene, when pre-Clovis, Clovis, Folsom, and/or Angostura hunters roamed the Rio Grande-Chihuahua vegetational zone, probably then a grassland where now-extinct types of buffalo, mammoth, sloth, antelope, horse, tapir, camel, and the like grazed. In the mountains, at low elevations, an oak-pine forest flourished. The shift from the Pleistocene to the Holocene was a momentous one for our hunters, for the climatic changes it brought caused a shift from grassland to desert, in the process of which many herd animals disappeared.

This change affected the hunters in a way that never had happened before. The Paleo-Indian response to previous glacial or climatic changes had been to shift from being rich hunters to being poor ones. They had not developed numerous other subsistence options or eco-knowledge. With the onset of the Holocene, people faced the possibility of changing from hunters to foragers and/or collectors with a broad-spectrum procurement system. In the Hueco basin, we see this shift as being from Clovis, Folsom, and Angostura to the initial Archaic stage of Gardner Springs, a trend that continued into the Keystone phase (about 4000 B.C.). During this second stage, people developed a subsistence based on seasonal scheduling and resource specialization in seed collection, as the rise of numerous types of grinding tools attests. Our first change, therefore, was a positive feedback system involving diminishing biomass, use of a broad-spectrum collecting system, specialization in seed collecting, and seasonal scheduling that further diminished the biomass, and so on, in a continuous cycle. By Keystone times a new way of life had developed.

Phase 2: Efficient Foragers. During the Keystone phase the efficient desert foraging system (Efficient Foraging Bands, System D) underwent further changes as a result of other causes. Climatic conditions worsened during the post-glacial optimum, and rainfall became less and less reliable. The foragers made increasing visits to the lush Rio Grande gallery forest, a thicket ecozone. Here they established seasonal base camps, often occupying pithouses. The increasing sedentarism encouraged a slow population growth, which made the foragers ready to adopt other subsistence options or specializations, a second positive feedback cycle.

Phase 3: Foragers with Domesticates. The Fresnal way of life that appeared at about 2600 B.C. was characterized by Semi-Sedentary Bands with Domesticates (System D). Fresnal saw the shift from a calendar-round system of seasonal scheduling to one with pithouse base camps or macroband camps out of which people made forays in certain seasons. As in Keystone times, sedentarism increased and the population grew relatively rapidly, causing the people to adopt domesticates such as corn and pumpkins from Mesoamerica as a supplement to their wet-season collecting. The growing reliance on corn in this arid environment led to the development of a new hybrid–Proto-Maiz de Ocho–which yielded more food. Growing dependence on this corn in turn led to more sedentarism, more mouths to

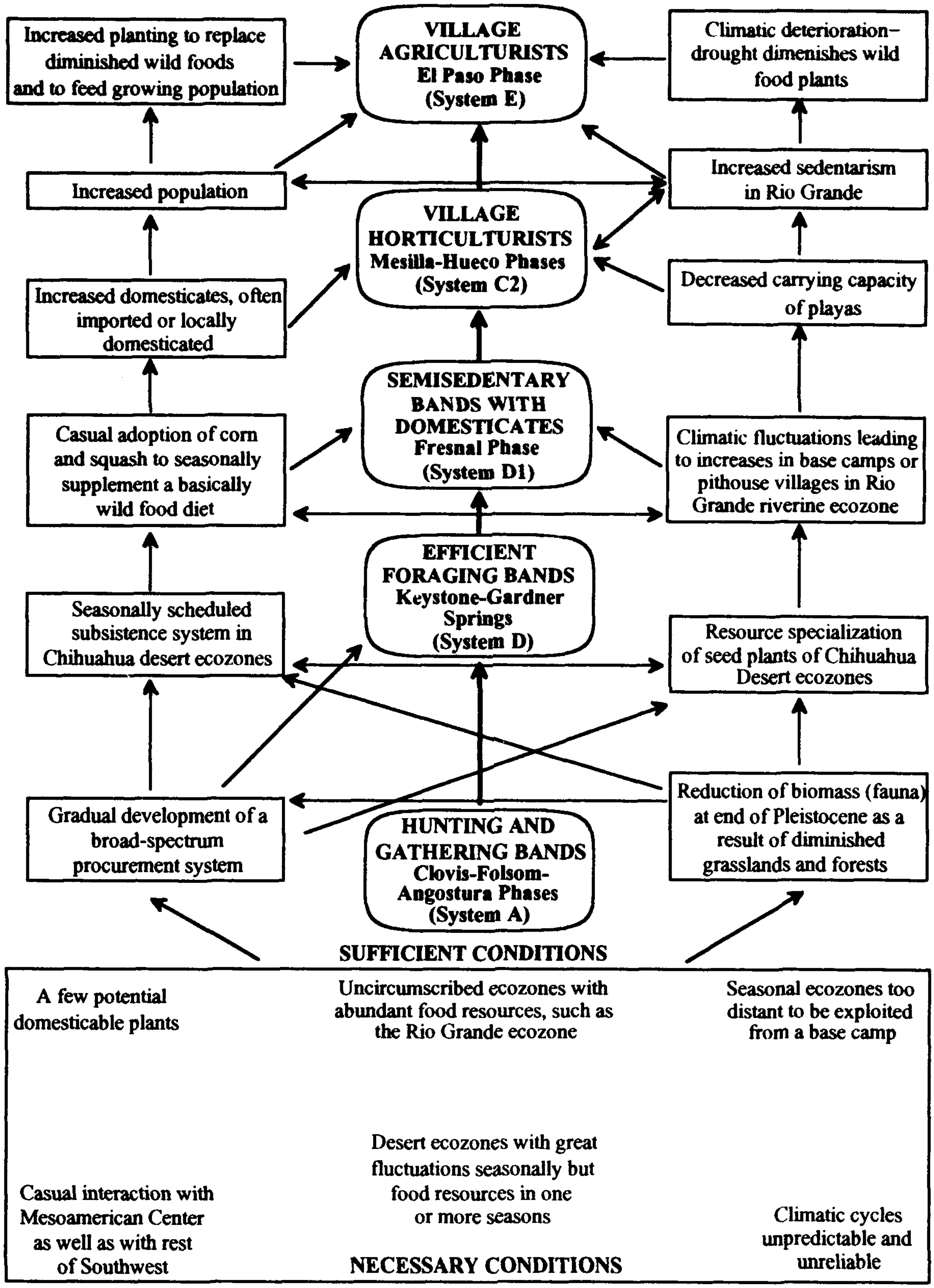


Figure VI-6. Necessary and Sufficient Conditions for the Development of Village Agriculture in the Jornada Region of the American Southwest

feed and increasing use of bigger base camps with more people, and so on, establishing a third positive feedback cycle that led to the Hueco and Mesilla phases, 900 B.C.-A.D. 1000, with a Horticultural Villagers' way of life (System D1).

Phase 4: Village Horticulture to Village Agriculture. The Hueco stage of horticulture reveals increasing sedentarism resulting from longer and longer stays at pithouse villages or base camps, with the result that the population grew relatively rapidly, which necessitated increasing amounts of food and resulted in adoption of more domesticates such as beans, amaranth, and squash *(Cucurbita mixta)*, production of new corn races–Maiz de Ocho and Pima-Papago–and more and more planting of those crops. Our C13/12 and N15/14 studies, however, show the Hueco people still were eating a great deal of wild plants and limited amounts of domesticates, so we surmise they were practicing seasonal horticulture rather than agriculture.

Late in the Mesilla period another element was added to the positive feedback cycle. A long drought, lasting from A.D. 700-1000 (Horowitz et al. 1981), forced the horticulturists to undertake sufficient planting to support populations at sedentary year-round pueblos. By the Doña Ana and El Paso time periods (A.D. 1100-1300) the Jornada people were village agriculturists. Other factors, such as a breakdown in the redistribution system and new kinds of social organization, also may have contributed to the final positive feedback cycle, but our archaeological evidence does not provide clear enough data to substantiate this idea.

We thus have an especially slow development from hunters to village agriculturists through very specific evolutionary stages–efficient foragers to foragers with domesticates, to village and base camp horticulturists, to village agriculturists–with each stage being brought about by specific causes operating in four different positive feedback cycles. In other words, the people became rescheduled in four different stages (Flannery 1968), rather than making one simple shift that resulted from one set of causes or a single cause (Cohen 1977b). Figure VI-6 shows the generalized stages of this tertiary type of development.

Development in Other Parts of the Southwest

Now we can ask, did the other Southwestern Archaic developments that resulted in village agriculture operate in the same way? Our evidence from the Oshara tradition (Irwin-Williams 1973), the best worked-out sequence for the Southwest, seems to indicate the answer is NO. In fact, we believe not only do the stages of the development from hunters to farmers differ, but so do the causes of change and the kinds of positive feedback cycles involved. One of the reasons the Oshara development is different from the Jornada is that many of the necessary conditions or prerequisites differ significantly. Obviously, both traditions are located in the great North American Desert; both had few domesticable plants; and both had casual (indirect) contacts with Mesoamerica, which early became a center of agriculture. There the similarity ends.

The Oshara Tradition. The Colorado Plateau vegetational zone of the Oshara tradition is very different in terms of foodstuffs and ecozones from that of the Chihuahua Desert along the Rio Grande. Not only does the Colorado Plateau have more animals and a definite winter season, but it does not seem to have been subject to so many unpredictable climatic fluctuations, which made the Chihuahua region a harsher and more difficult place in which to live. The Colorado Plateau also seems to have a number of oasislike ecozones–Irwin's lagoon canyon heads or Black Mesa lowland canyon heads–lusher than anything in the Jornada, even though these lush areas are circumscribed by harsh zones and can be outgrown by their population. In fact, such lush zones may become bases for exploiting other ecozones in various seasons, creating a sort of centripetal effect rather than the centrifugal one we saw in the Chihuahua area. In the Jornada region the only really lush zone was the Rio Grande gallery forest, and it certainly was *not* circumscribed, nor could it be used as a base from which to exploit distant zones, such as the oak-pine or ponderosa forest of the surrounding mountains.

Still another causative factor, harder to define, may concern the interaction of the two areas. The Jornada or Chihuahua life zone, in terms of trade materials recovered, seems to have had limited Archaic contacts with the other Southwestern developments, whereas the Oshara tradition had more intense contacts with other areas. Perhaps this was a result of Oshara's more central position, or perhaps better passes and trade routes existed, or perhaps contacts were due to unfathomable social preferences. Whatever the cause, the Chihuahua development seems to be on the

fringe of the Southwestern Archaic interaction sphere. All of these necessary conditions meant rather different developments occurred in the Chihuahua and Oshara traditions.

What were the sufficient conditions or triggering causes that led to village agriculture in the Oshara development (see Figure VI-7)?

The first stage–from early hunters (Cody-Folsom) to early foragers–is similar to the Chihuahua tradition, but the foragers of the Bajada and Jay and possibly the Deshe phases seem more affluent than those of Gardner Springs, perhaps because the Colorado Plateau was not as harsh an environment. People in both regions, however, reacted to the diminishing post-Pleistocene biomass by turning to broad-spectrum procurement foraging systems that involved seasonal scheduling in different ways. Unlike Gardner Springs and Keystone in the Chihuahua tradition, Jay-Bajada-Deshe of the Oshara does not seem to have had seed resource specialization, early pithouses, or base camps, or a calendar-round sort of seasonal scheduling. Rather, the Oshara peoples seem to have placed more emphasis on hunting in favored localities and "repeated re-occupations of favorable localities with access to fixed groups of macroenvironments . . .", causing them to adapt "to year-round exploitation of local resources" from well-watered base camps (Irwin 1973). Thus, even if the causes of change were similar, the two developments seem to have been headed along different paths from the outset.

During the next phase, both the developmental stages and causes became even more noticeably different. While the Keystone people became desert foragers with domesticates, in the Oshara region groups were becoming more affluent forager bands (San Jose phase) or villagers (Armijo phase) at the lush, circumscribed canyon heads. Factors leading to change in Oshara were increasing populations that overexploited or outgrew the lush base camp areas and the development of more and better foraging subsistence strategies, not only at permanently watered bases, but also in the surrounding zones into which bands could make forays to acquire specific resources in specific seasons.

This positive feedback cycle could go just so far, and by 800 B.C., the end of Armijo, a food and population crisis suddenly had to be met. To increase the food supply, the Oshara people quickly adopted corn, beans, pumpkins, gourds, and squash as a horticulture complex (En Medio and Trujillo phases, or on the Colorado Plateau, Dog Cave and Lolomai phases), and became villagers, setting up a new positive feedback cycle. More food from horticulture meant more people living in circumscribed zones, which meant more local domestication of plants (tepary beans and runner beans) and more importations of domesticates such as moschata and mixta squash. In this way horticulture rapidly became agriculture and led by Sky Village times to still more population increases. Rapid change, therefore, was inevitable. Overexploitation of resources, climatic fluctuations and drought, and trade connections were minor factors that pushed along the two major causes of change. Thus, instead of a gradual drift into an unstable village agriculture, like that of the Chihuahua tradition, the Oshara development was a rapid plunge into farming and village life.

Developments in Other Areas. Finally, what about the rest of the Southwest and the great agricultural developments elsewhere in the world? At present there seem to be more questions than answers.

First let us look at the Cochise development of the Mogollon Rim environment. A great deal of research has been done in this area, not only at the famous Bat Cave (Dick 1965), but also near Reserve by Chicago's Field Museum from the 1940s into the 1960s (Martin et al. 1952). Yet the resulting data seem to provide no ready answers to questions such as the following. Certainly the Cochise environment was different from that of the Colorado Plateau and the Chihuahua Desert, but were the necessary conditions different as well? Superficially, they do look different, but are they? If not, were the Cochise Mogollon culture developments similar to or different from Jornada or Oshara?

Similar questions plague me when I consider the Cochise development in the Gila (and perhaps Colorado) Drainage of southern Arizona. Does the riverine system of the Gila mean the necessary conditions were like those along our central Rio Grande in the Jornada region? If so, was the Cochise development along the Gila similar to the Chihuahua tradition? Further, was it like that on the Mogollon Rim or the Colorado Plateau, or was it something different?

This brings us to the other side of the coin in our consideration of developments in the great North American Desert. Why didn't the peoples in the desert regions of California, Nevada, Utah, Colorado, Texas, and in Coahuila and Tamaulipas in Mexico develop village agriculture? Weren't their connections to the Mesoamerican heartland just as good? Were their environments perhaps too harsh for the development of agriculture? Or did they, when faced with environmental and population crisis, take up other subsistence options, such as moving to the lush coast in California, or to lagoon areas, or to other regions entirely?

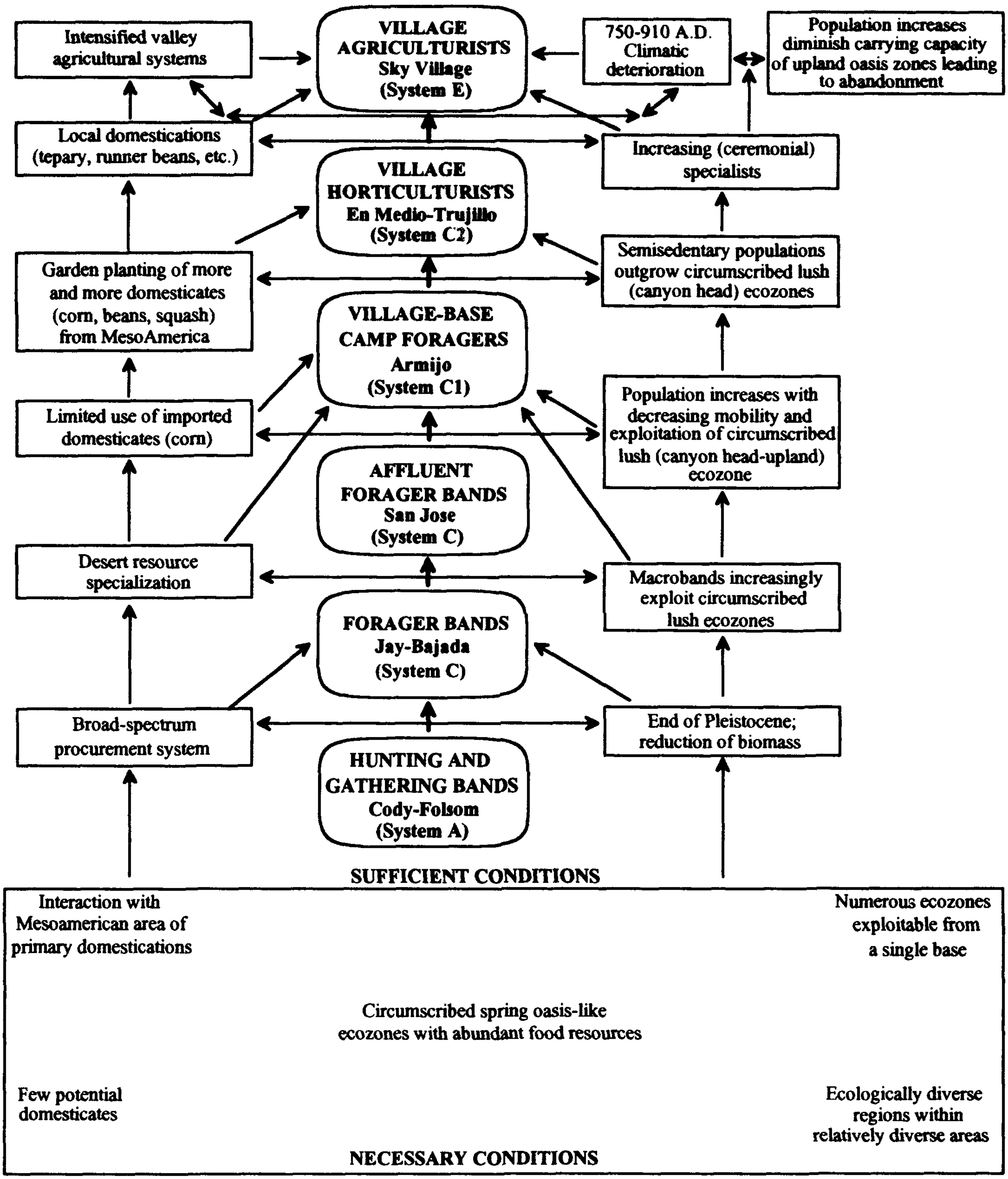


Figure VI-7. Necessary and Sufficient Conditions for the Development of Village Agriculture in the Eastern Colorado Plateau Region

Last, but far from least, we come to the even wider problems concerning the development of village agriculture all over the world. Can our model of the development of agriculture for the Jornada region of the Chihuahua Desert serve as a hypothesis about similar developments elsewhere? Did the development in the Sahara region of Africa happen in a similar way for similar reasons? Does all late development of agriculture in noncenters (places that did not originate agriculture) follow a pattern of gradual change from efficient foragers to foragers with domesticates, to villagers with horticulture, to village agriculturists? Can we say this holds true for Europe, the Eastern United States, and much of the New World Tropics? Were the reasons for development the same (MacNeish 1992)?

A further set of questions concerns the type of rapid development found in the Oshara tradition. Did this Oshara type of development, which saw hunters shift to affluent foragers, then to village foragers, then quickly to village agriculturists, occur elsewhere? Were population growth and carrying capacity of the environment the prime motivating factors with this type of development, a la Cohen (1977b)? Can we say the Oshara type of development occurred, for the same reasons, in the Levant and the lowlands of the Near East, the coasts of Mesoamerica, Peru, and China, the lands around the Aegean Sea, the New World tropical coasts, the Sudan, Egypt, and Southeastern Asia?

Finally, we come to the question nearest and dearest to my heart. Were not both the Chihuahua and Oshara types of development radically different from the long, slow primary ones that occurred in the centers of the world–highland Mesoamerica (MacNeish et al. 1975), highland Peru (MacNeish 1981), the Hilly Flanks of the Near East (Redman 1978:86-176), and the inland Yellow River of China (Chang 1971)–the first areas to develop village agriculture (see Figure I-2). What were the sequences in these areas and how different were they from those in the Southwest? Further, how different were their causes?

Further Problems and Recommendations

Our questions about the development of village agriculture in the Southwest thus are not the end of our search but rather the first stage in an understanding of one of the greatest developments in human history–the beginnings of agriculture. Needless to say, much research remains to be done in many areas. As far as our area of investigations in this volume–the Jornada region of south-central New Mexico–is concerned, we have a number of suggestions about what might be done to solve specific problems about the origin of agriculture there.

We obviously need more information on the Archaic period and its four phases. We have very few Gardner Springs sites, and those are small, poverty-stricken open sites. We have no caves with perishable artifacts and plant remains. To find more sites, we need well-executed archaeological reconnaissance that does settlement-pattern hypothesis testing–identifying the ecological setting, then intensively surveying appropriate settlement spots. A similar reconnaissance and testing is needed to add to our knowledge of the 23 open Keystone sites. Although we need less problem-oriented survey for the Fresnal and Hueco phases, feasibility studies should be undertaken to find out if we have the right kinds of sites or ideal sites to dig.

By ideal sites I mean ones in each of the ecological zones, for peoples of the Chihuahua Archaic were semisedentary. Obtaining this ideal will be very difficult because the Jornada area has been looted extensively, and the expansion of modern facilities is further eliminating the archaeological record. Ideally, our record should include sites in different ecological zones with burials, dry cave components, task force sites, microband/macroband encampments, and pithouse sites. Hopefully, some of these sites would be dry caves containing an abundance of material for analysis–feces, plant and animal remains, and material datable by a number of techniques.

This brings us to another level of recommendation in the realm of analysis–interdisciplinary research. We obviously need more ecological studies of the Jornada region and its ecosystem. The botanical study by Anderson and Dawson's zoological study are steps in that direction. We especially need studies focused on the problem of ecological changes that have occurred in the past 10,000 years, for such changes may be possible causes of shifts in subsistence patterns. Our zoological research, therefore, might emphasize studies of small mammals that are sensitive to climatic change, along the line of the studies done by Dr. A. Harris (1988). Correlated with the zoological program should be studies of rock composition and geological changes, like the research of Hawley (Gile et al. 1981) and research in palynology to further the preliminary conclusions of Van Devender and Spaulding (1979). To pull all these data together, we need some new techniques, such as the H2/1 and O18/16 isotopic studies that we are beginning to undertake with Marino (Marino et al. 1990), which are summarized on the following page:

H_2O and HDO are important climatic tracers used to characterize continental paleoclimates, typically using data from ice cores. The hydrogen and oxygen isotopic ratios of precipitation that fell over middle to low latitude continents in the past, however, are not well known. Tree ring cellulose isotopic studies have not produced a coherent record. Typically only hydrogen isotope ratios are reported for tree ring cellulose, however, the relationship between hydrogen and oxygen isotope ratios in precipitation is climatically sensitive. We have analyzed the stable hydrogen and oxygen isotope ratios of temporal and spatial collections of a single species of plant, Zea Mays, to determine the coherence of the isotopic signal compared to modern precipitation data reported by the IAEA and others. We investigate relationships between (1) beta D, beta^{18}O of cellulose and beta D, beta^{18}O of precipitation (IAEA); (2) beta D, beta^{18}O of cellulose with climatic and meteorological data (e.g. temperature, precipitation); (3) beta D, beta^{18}O cellulose and beta D, beta^{18}O water used for growth; (4) beta D vs. beta ^{18}O cellulose and beta D vs. beta^{18}O measured in precipitation (IAEA). These studies are necessary to determine the potential use of stable hydrogen and oxygen isotope ratios to infer past precipitation values that could then be used to reconstruct past states of regional hydrologic cycles within the context of global scale models in which the stable isotopic composition of H_2O can be related to planetary radiative and biological parameters.

Studies such as the above are fundamental to an understanding of the place of ecological change in the development of agriculture. They certainly should not be arrogantly relegated to appendices in monographs as recommended by the BLM.

Intimately connected with this level of analysis and interdisciplinary studies is research concerned with how people exploited these ecosystems for food, and how they lived on the land in these changing ecosystems–that is, studies of subsistence and settlement patterns and/or population investigations. As Cohen (1977b) has indicated, population and settlement patterns may be key causative factors in bringing about agriculture, so we must start to undertake more sophisticated studies of the data we cull in our "ideal" future surveys and excavations. The same is true of subsistence studies, and these require preserved subsistence materials recovered from cave excavations that can be combined with coprolite studies (Bryant 1985), "garbage analysis" (MacNeish 1967:310), and expanded C13/12 and N15/14 investigations of the type described in Chapter III.

In the realm of Archaic technology–another form of exploitation of the ecosystem–we need more sophisticated investigations in terms of typology and material use-wear analysis, for which Chapter V shows the beginnings. Even further behind are studies concerned with the reconstruction of the changing Archaic social organization in the Chihuahua tradition. There seems to be an assumption that the band type of social organization and religion was so simple in the Southwest that it probably could not have caused culture change (Cordell 1984). I cannot help but wonder if such an assumption is valid. After all, the Australian Aborigines, with a collecting subsistence system and band settlement pattern similar to our Archaic phases, had a very complex system of kinship, marriage, and family, as well as a rich ceremonial life. The complex bone bead sash of burial 6 at Todsen Cave and other Archaic burials, such as at Lolomai on Black Mesa, as well as the complex pictographs on walls of caves containing Archaic remains, hint that we may have an overly simplistic picture of the Archaic. Certainly we need more sophisticated studies of Archaic pictographs (P. Schaafsma 1980) and burials to help us better reconstruct Archaic social organization and systems of value.

On every level we need more data and more sophisticated analysis of information before we can understand the causes of the origin of agriculture in the Southwest convincingly. Recent trends in the Southwest, however, do not seem headed in this problem-oriented direction, for most time and money seem to be spent on salvage rather than problem-oriented research. Unfortunately, government agencies and their inadequately trained archaeological personnel, with their multitude of regulations oriented toward salvage rather than research, more often impede problem-oriented archaeology, waste archaeological time and scarce money, and often allow the looter first crack at the sites professionals should be digging. It seems time to cut the red tape that many regard as an umbilical cord and give archaeology back to the archaeologists. We hope this government-sponsored monograph that presents the results of problem-oriented preliminary investigations by a private foundation is a step in this more fruitful direction. Perhaps archaeology in the Southwest once again can become Archaeology.

REFERENCES

Adovasio, J.M., and Joel Gunn

1977 Style, Basketry and Basket Makers. In *The Individual in Prehistory*, James Nihill and Joel Gunn, eds. Academic Press, New York.

Adovasio, J.M., J.D. Gunn, J. Donahue, and R. Stuckenrath

1975 Excavations at Meadowcroft Rockshelter, a Progress Report. *Pennsylvania Archaeology* 45:3. I-93.

Alexander, Herbert L.

1987 *Putu, A Fluted Point Site on Alaska.* Department of Archaeology, Simon Frazer University, 17. Barnaby, British Columbia.

Anderson, Sally

1993 Archaic Period Land Use in the Southern Tularosa Basin, New Mexico. In Preliminary Investigations of the Archaic in the Region of Las Cruces, New Mexico. *Historic and Natural Resources Report.* Andover Foundation for Archaeological Research, Andover, Massachusetts, and Directorate of Environment, U.S. Army, Fort Bliss, El Paso, Texas.

Anyon, Roger, and Steven A. LeBlanc

1984 *The Galaz Ruin: A Prehistoric Mimbres Village in Southwestern New Mexico.* Maxwell Museum of Anthropology and University of New Mexico Press.

Arnold, Dean E.

1985 *Ceramic Theory and Cultural Process.* Cambridge University Press.

Arnold, J.R., and W.F. Libby

1950 *Radiocarbon Dates.* Chicago: University of Chicago Institute of Nuclear Studies.

Baily, Vernon

1971 *Mammals of the Southwestern United States: With Special Reference to New Mexico.* Dover, New York.

Barcena, Joaquin-Garcia

1981 Una Pienta Acanalada de la Cueva los Grifos, Ocho Cautla, Chaipas, Dept. de Prehistoric, INAN, Mexico.

Batcho, David G.

1984 Obsidian Hydration Studies at the Grants Prison Sites: Dating the San Jose Complex. *Cultural Resources Management Division Report* 590. New Mexico State University, Las Cruces.

Beal, John D.

1981 A Revised Culture History for a Portion of the San Juan Basin, New Mexico. In Archaeological Essays in Honor of Mark Wimberly, Michael S. Foster, ed. *The Artifact* 19(3&4):85-100. El Paso Archaeological Society.

Beckett, Patrick
1980 *The AKE Site.* Department of Sociology and Anthropology, Cultural Resource Management Division, New Mexico State University, Las Cruces.

1973 *Cochise Culture Sites in South Central and North Central New Mexico.* MA thesis. Eastern New Mexico University, Portales.

Beckett, Patrick, and R.S. MacNeish
1987 The Archaic Tradition of South Central New Mexico and Chihuahua, Mexico. *Coas Books,* Monograph 7, Las Cruces, New Mexico.

Beckett, Patrick, and Thomas O'Laughlin
1968 Spring Canyon Cave Excavation LA5531. Mimeographed paper on file, New Mexico State University Museum, Las Cruces.

Bell, Robert E.
1960 Guide to the Identification of certain American Indian Projectile Points. *Special Bulletin of the Oklahoma Anthropological Society* No. 1-2. Norman.

Berry, Michael
1982 *Time, Space, and Transition in Anasazi Prehistory.* University of Utah Press, Salt Lake City.

Berry, Michael S.
1985 The Age of Maize in the Greater Southwest: A Critical Review. In Prehistoric Food Production in North America, R.I. Ford, ed., *Anthropology Papers,* No. 75, Museum of Anthropology. University of Michigan, Ann Arbor.

Binford, Lewis R.
1964 A Consideration of Archaeological Research Design. *American Antiquity* 29(405-41).

Bohrer, Vorsila D.
1981 Former Dietary Patterns of People as Determined from Archaic-Age Plant Remains from Fresnal Shelter, South-central New Mexico. In Archaeological Essays in Honor of Mark Wimberly, Michael S.Foster, ed. *The Artifact* 19(3&4):51-68. El Paso Archaeological Society.

1972 Tentative List of Utilized Plant Remains from Fresnal Shelter. In *Technical Manual,* pp. 211-19. Human Systems Research. Tularosa, New Mexico.

Braidwood, Robert J.
1967 *Prehistoric Men.* 2nd Edition. Scott, Foresman. Glenview, Ilinois.

Brown, W.L.
1974 Review of Corn: Its Origin, Evolution and Improvement, by Paul C. Mangelsdorf. *Science* 185:687-88.

Brown, W.L., and E. Anderson
1947 The Northern Flint Corns. *Annals of the Missouri Botanical Gardens* 34 (1):1-28.

Bruier, Frederick L.
1976 New clues to stone tool functions: Plant and animal residues. *American Antiquity* 41:478-84.

Bryan, Kirk, and J.H. Toulouse, Jr.
1943 The San Jose Non-Ceramic Culture and its Relation to Puebloan Culture in New Mexico. *American Antiquity* 8(3):269-288. Menasha, Wisconsin.

Bryant, Vaughan
1985 Prehistoric Diet in Southwest Texas: The Coprolite Evidence. *American Antiquity* 39(3):143-56.

Budd, L.F., et al.
1979 *Fort Bliss Environmental Analysis and Impact Statement*. Photographic Interpretation Corporation. Hanover, New Hampshire.

Bussey, Stanley D., Richard Kelly and Judith Southward
1976 LA4921, Three Rivers, Otero County, New Mexico: A project of excavation, stabilization, and interpretation of a prehistoric village. *New Mexico State University Cultural Resources Management Division Report*.

Campbell, E.W., and W.H. Campbell
1935 The Pinto Basin Site. *Southwestern Museum Paper* No. 9. Los Angeles, California.

Cameron, Cathy
1973 Analysis of "low muscle mass" bone in relation to hearth areas. *Technical Manual*, pp. 398-402. Human Systems Research. Tularosa, New Mexico.

Cantwell, Anna Marie
1979 The Functional Analysis of Scrapers from New Technique and Cautions. Newsletter, *Lithic Technology* 8(1). Richmond, Virginia.

Cardich, Augusto, Lucio Adele Cardich, and Adam Hajdak
1973 Secuencia Argaeologia y Cronologia Radiocarbonica de la Cueva 3 de Los Toldos, Santa Cruz, Argentina, *Relacions*, tomo VII. Sociedad Argentina de Anthropologia, Buenos Aires.

Carmichael, David L.
1982 *New Radiocarbon Dates and Evidence for Early Cultigens at Fresnal Shelter, New Mexico*. Department of Anthropology, University of Illinois, Urbana.

1981 *Fresnal Shelter, New Mexico: Preliminary dating and evidence for early cultigens*. Paper presented at the 47th meeting of the Society for American Archaeology, Minneapolis.

1986 Archaeological Survey in the Southern Tularosa Basin of New Mexico. *Publication in Anthropology* No. 3, Environmental Management Office, Directorate of Engineering and Housing, U.S. Army Air Defense Artillery Center, Fort Bliss, Texas.

Chang, K.C.
1971 *The Archaeology of Ancient China*. Yale University Press, New Haven.

Clemons, Russell E.
1976 Sierra de Las Uvas Ash-Flow Field, South-Central New Mexico. In Tectonics and Mineral Resources of Southwestern North America. Lee A. Woodward and Stewart Northrop, eds. *New Mexico Geological Society Special Publication* 6:115-21.

Cohen, Mark N.
1977a Population Pressure and the Origin of Agriculture: An Archaeological Example from the Coast of Peru. In *Origin of Agriculture*, Charles Reed, ed. Morton, The Hague.

1977b *The Food Crisis in Prehistory: Overpopulation and the Origins of Agriculture*. Yale University Press, New Haven.

Cordell, Linda
1984 *Prehistory of the Southwest*. Academic Press, Orlando.

Correal, Gonzalo
1986 Apuntes Sabre el Medio Ambiente Pleistocenico ye el Hombre Prehistorico en Columbia. In *New Evidence for the Pleistocene Peopling of the America*, Alan Boyon, ed. University of Maine, Orono.

Cosgrove, C.B.
1947 Caves of the Upper Gila and Hueco Areas in New Mexico and Texas. *Paper of the Peabody Museum of American Archaeology and Ethnology* Vol. 42. Harvard University, Cambridge, Massachusetts.

Cosgrove, H.S., and C.B. Cosgrove
1932 The Swartz Ruin: A Typical Mimbres Site in Southwestern New Mexico. *Papers of the Peabody Museum of American Archaeology and Ethnology* 15 (1), Harvard University, Cambridge, Massachusetts.

Cummings, Byron
1928 *Cochise of Yesterday in Arizona, Old and New*. Tucson, Arizona.

Cutler, Hugh C.
1952 A Preliminary Survey of Plant Remains of Tularosa Cave. In Mogollon Cultural Continuity and Change: The Stratigraphic Analysis of Tularosa and Cordova Caves, Paul S. Martin et al., eds. *Fieldiana: Anthropology* 40: 461-80. Natural History Museum, Chicago.

Dawson, Peter
1993 Use-Wear Patterning on Expedient Tools. In Preliminary Investigations of the Archaic in the Region of Las Cruces, New Mexico. *Historic and Natural Resources Report*. Andover Foundation for Archaeological Research, Andover, Massachusetts, and Directorate of Environment, U.S. Army, Fort Bliss, El Paso, Texas.

1993 Faunal Remains from Todsen Cave. In Preliminary Investigations of the Archaic in the Region of Las Cruces, New Mexico. *Historic and Natural Resources Report*. Andover Foundation for Archaeological Research, Andover, Massachusetts, and Directorate of Environment, U.S. Army, Fort Bliss, El Paso, Texas.

DeNiro, Michael J.
1987 Stable Isotopy and Archaeology. *American Scientist* 75:182-91.

DeNiro, Michael J., and Samuel Epstein
1978 Influence of Diet on the Distribution of Carbon Isotopes in Animals. *Geochimic et Cosmochimica Acta* 42:495-50.

Dick, Herbert W.
1965 Bat Cave. *Monograph* No. 27. School of American Research, Santa Fe.

Downs, Elinor F.
1985 An Approach to Detecting and Identifying Blood Residues on Archaeological Sstone Artifacts: A Feasibility Study. Unpublished ms., Center for Materials Research in Archaeology and Ethnology, Massachusetts Institute of Technology, Cambridge.

Dunham, Kingsley
1935 The Geology of the Organ Mountains. *New Mexico Bureau of Mines and Mineral Resources Bulletin* 11. Socorro.

Elston, Wolfgang E.
1976 Glossary of Stratigraphic Terms of the Mogollon-Datil Volcanic Provenience, New Mexico. In Cenozoic Volcanism in Southwestern New Mexico, Wolfgang E. Elston and Stewart A. Northrop, eds. *New Mexico Geological Society Special Publication* 5:131-44.

Epstein, J.F.
1963 Centipede and Damp Caves. Excavations in Val Verde County, Texas, 1958. *Bulletin of the Texas Archaeological Society* 33. Austin.

Etchieson, Meeks
1987 Limited Testing at LA854, Doña Ana Co., New Mexico. Department of Interior, Bureau of Reclamation. Amarillo, Texas.

Evans, C.T.
1989 An Analysis of Burials from the Old Socorro mission, Socorro, Texas. *The Artifact* 27(1):1-4.

Farnsworth, Paul, James E. Brady, Michael J. DeNiro and Richard S. MacNeish
1985 A Re-evaluation of the Isotopic and Archaeological Reconstructions of Diet in the Tehuacán Valley. *American Antiquity* 50(1):102-16.

Ferdon, Edwin N., Sr.
1946 An Excavation of Hermit's Cave, New Mexico. *Monograph* No. 10. School of American Research, Santa Fe.

Flannery, Kent V.
1968 Archaeological Systems Theory and Early Mesoamerica. In *Anthropological Archaeology in the Americas, Anthropological Series*. Washington, D.C.

Ford, James A.
1962 A Quantitative Method for Deriving Cultural Chronology. *Pan American Union Technical Manual* No. 1, Washington, D.C.

Ford, Richard I.
1985 Prehistoric Food Production in North America, *Anthropological Papers* No. 75, Museum of Anthropology. University of Michigan, Ann Arbor.

1981 Gardening and Farming Before A.D. 1000: Patterns of Prehistoric Cultivation North of Mexico. *Journal of Ethnobiology* 1(1):6-27.

Galinat, Walton C.
1987 Data on File with the Author. Suburban Experiment Station, University of Massachusetts, Waltham.

1985 Domestication and Diffusion of Maize. In Prehistoric Food Production in North America. R.I. Ford, ed., *Anthropological Papers* No. 75. Museum of Anthropology, University of Michigan, Ann Arbor.

1967 Plant Habit and the Adaptation of Corn. *Massachusetts Agricultural Experiment Station Bulletin* 565:1-17.

Galinat, Walton C., T.R. Reinhard, and T.R. Frisbie
1970 Early Eight-Rowed Maize from the Middle Rio Grande Valley, New Mexico. *Botanical Museum Leaflets* 22:313-31, Harvard University.

Galinat, Walton C., and R.G. Campbell
1967 The Diffusion of Eight-Rowed Maize from the Southwest to the Central Plains. *Massachusetts Agricultural Experiment Station Monograph Series* No. 1. University of Massachusetts, Amherst.

Galinat, Walton C., and J.H. Gunnerson
1963 Spread of Eight-Rowed Maize from the Prehistoric Southwest. *Botanical Museum Leaflets* 20:117-160, Harvard University.

Garrett, Elizabeth M.
1987 Petrographic Analysis of 36 Unspecified Bbrownware Ceramics from Santa Teresa Excavation. In *Prehistoric land use in the Mesilla Basin: Excavations on the Navajo-Hopi land exchange near Santa Teresa, New Mexico,* Beth O'Leary, ed., pp. 255-65. Office of Contract Archaeology, University of New Mexico, Albuquerque.

Gerald, Rex
1988 Pickup Peublo: A Late Prehistoric House Ruin in Northeast El Paso. *The Artifact* 26(2)1):85.

Gile, L.H., J.W. Hawley, and B. Grossman
1981 Soils and Geomorphology in the Basin and Range of Southern New Mexico. *New Mexico Bureau of Mines and Mineral Resources, Memoir* 39, Socorro, New Mexico.

Gladwin, Harold S., E.W. Haury, E.B. Sayles, Nora Gladwin
1937 Excavation at Snaketown. Material Culture. *Medallion Paper* No. XXV. Globe, Arizona.

Glassow, Michael A.
1972 Changes in the Adaptations of Southwestern Basketmakers: A System Perspective. In *Contemporary Archaeology,* Mark Leone, ed., 289-302. Southern Illinois University Press, Carbondale.

Griffen, James B., and R.A. Yarnell
1963 A New Radiocarbon Date from the Davis Site, Cherokee County, Texas. *American Antiquity* 28:396-97.

Grobman, A., W. Salhuana, and R. Sevilla in collaboration with Paul C. Mangelsdorf
1961 Races of Maize in Peru. *National Research Council Publication* 915:1-374. National Academy of Sciences, Washington, D.C..

Guernsey, Samuel J.
1931 Explorations in Northeastern Arizona. *Papers of the Peabody Museum of American Archaeology and Ethnology*. Harvard University, Cambridge, Massachusetts.

Guernsey, Samuel J., and A.V. Kidder
1921 Basket-Maker Caves of Northeastern Arizona. *Papers of the Peabody Museum of American Archaeology and Ethnology*. Harvard University, Cambridge, Massachusetts.

Guidon, Niede
1986 Las Unidades Culturales de Sao Raimundo Nonato, Sudeste del Estado de piaui, Brazil. In *New Evidence for the Pleistocene Peopling of the America*, Alan Bryon, ed. University of Maine, Orono.

Gummerman, G.J., ed.
1971 The Distribution of Prehistoric Population Aggregates. Prescott College Press, *Anthropoligical Report,* No. 1.

Gummerman, G.J., and R.C. Euler
1976 *Papers on the Archaeology of Black Mesa, Arizona*. Southern Illinois University Press, Carbondale.

Hall, Raymond, and Keith Kelson
1959 *Mammals of North America*. Ronald Pub. Co., Vols.1 and 2.

Hammack, Laurens C.
1962 LA5599: A pithouse village near Rincon, New Mexico. *Laboratory of Anthropology Notes* No. 8. Museum of New Mexico, Santa Fe.

Harlan, Jack R.
1971 Agricultural Origins: Centers and Non-Centers. *Science* 174 (4008):468-73.

Harris , Arthur H.
1988 Late Pleistocene and Holocene Microtis in New Mexico. *Journal of Vertebrate Paleontology* 8(3), Society of Vertebrate Paleontology.

Haury, Emil W.
1983 Concluding Remarks. In *The Cochise Cultural Sequence in Southeastern Arizona,* E.B. Sayles, et al., eds., pp. 162-65. University of Arizona Press, Tucson.

1962 The Greater American Southwest. In *Courses Toward Urban Life,* R.J. Braidwood and G. Willey, eds. Aldine, Chicago.

1950 Artifacts with Mammoth Remains, Naco, Arizona. Discovery of the naco Mammoth and Associated Projectile Points. *American Antiquity,* No. 19. Salt Lake City, Utah.

1950 *The Stratigraphy and Archaeology of Ventana Cave, Arizona.* University of Arizona Press, Tucson.

1936 Some Southwestern Pottery Types IV. *Medallion Papers* 19. Globe, Arizona.

Haury, Emil, E.B. Sayles, and W.W. Wasley
1959 The Lehner Mammoth Site, Southeastern Arizona. *American Antiquity* 25:2-30.

Hemmings, E. Thomas, and Vance Haynes
1969 The Escapale Mammoth and Associated Projectile Points, San Pedro Valley, Arizona. *Journal of Arizona Academy of Science* 5:3.

Hester, Thomas R.
1980 *Digging into South Texas Prehistory.* Corona Publishing Co., San Antonio.

Heymann, M.
1975 *Reptiles and Amphibians of the American Southwest.* Double Shoe Publishers, Scottsdale, Arizona.

Hibben, Frank
1941 Evidence of Early Occupation of Sandia Cave, New Mexico, and Other Sites in the Sandia-Manzano Region. Smithsonian Miscellaneous Collection, Vol. 99. Washington, D.C.

Hill, David V.
1986 Archaeological Monitoring of the AT&T Fiber Optics Line near Mason Draw, Doña Ana County, New Mexico. *Cultural Resources Management Division Report* 632. New Mexico State University, Las Cruces.

1987 Estimating Temper Particle Size. *Pottery Southwest* 14(3):2,4.

1988 Petrographic Analysis of Loop 375 Ceramics (Phase II). In Loop 375 Archaeological Project Fort Bliss Maneuver Area I, El Paso County, Texas. Appendix H. University of Texas at El Paso and Centennial Museum.

1989a Preliminary Ceramic Analysis for Loop 375. In an Interim Report for Phase II Additional Testing and Recommendations for Phase III Data Recovery, Loop 375 Data Recovery Project, El Paso County, Texas. University of Texas at El Paso and Centennial Museum.

1989b Petrographic Analysis of Mimbres Phase Ceramics. Ms. on file, Human Systems Research Inc. Mesilla Park, New Mexico.

1990a Ceramic Technology: Making Ceramics for Use on Black Mesa. In *Function and Technology of Anasazi Vessels and Facilities from Black Mesa, Arizona,* Marion F. Smith, ed. Center for Archaeological Investigations, Southern Illinois University at Carbondale, in press.

1990b *Ceramic Production and Settlement Patterns in the Paso del Norte.* Paper presented at Segundo Congresso: Historia regional comparada. Direccion General de Investigacion y Estudios Superiores, Universidad Autonoma de Cuidad Juarez, Mexico.

Holden, W.C.
1938 Blue Mountain Rockshelter. *Bulletin of the Texas Archaeological and Paleontology Society* Vol. 10. Austin.

Horowitz, A., Rex E. Gerald, and M.S. Chaiffetz
1981 *Preliminary PaleoEnvironmental Implications of Pollen Analysis from Mesilla, El Paso, and Historic Sites near El Paso.* Centennial Museum, University of Texas, El Paso.

Huckell, Bruce B., and Lisa W. Huckell
1988 *Crops Come to the Desert: Late Preceramic Agriculture in Southeastern Arizona.* Papers presented at the Society for American Archaeology meeting, Phoenix.

Humphrey, Robert R.
1958 The Desert Grassland: A History of Vegetational Change and an Analysis of Causes. University of Arizona Press, Tucson. Republished from *The Botanical Review* 24(4). University of Arizona Press, Tucson.

Hunt, A., and D. Tanner
1960 Early Man Site near Moab, Utah. *American Antiquity*, 26(1).

Irwin-Williams, Cynthia
1979 Post-Pleistocene Archaeology 7000-2000 B.C. in *Handbook of North American Indians, Southwest,* Alfonso Ortiz, ed., Vol. 9:33-42. Smithsonian Institution, Washington, D.C.

1973 The Oshara Tradition: Origins of Anasazi Culture. *Eastern New Mexico University, Contributions in Anthropology*, 1(1), Portales.

1967 Association of Early Man with Horse, Camel, and Mastodon at Hueyatlaco, Valsequillo (Puebla, Mexico), in *Pleistocene Extinctions,* P.S. Martin, ed., pp. 337-47. Yale University Press, New Haven.

Irwin-Williams, Cynthia, and Henry J. Irwin
1966 Excavations at Magic Mountain. *Denver Museum of Natural History Proceeding* 12, Denver.

Irwin, Henry J., and Cynthia C. Irwin
1959 Excavations at the Lo Daiska Site in the Denver, Colorado Area. *Denver Museum of Natural History Proceeding* 8, Denver.

Jennings, Jesse D.
1978 Prehistory of Utah and the Eastern Great Basin. *Anthropological Paper* No. 98, University of Utah, Salt Lake City.

1964 The Desert West. In *Prehistoric Man in the New World.* Jennings and Norbeck, eds. University of Chicago Press, Chicago.

1940 A Variation of Ssouthwestern Pueblo Culture. *Laboratory of Anthropology Technical Series Bulletin* 10, Santa Fe, New Mexico.

Johnson, Frederick, comp.
1951 Radiocarbon Dating. *Society for American Archaeology Memoir* 17.

Johnson, M., and Steadman Upham
1987 Approaches to Adaptive Diversity: A Preliminary Report on Archaeological Investigations in the Southern Organ Mountains, New Mexico. *Proceedings of the 4th Jornada Mogollon*

Conference, K. Laumbach and P. Eidenbach, eds. Human Systems Research. Tularosa, New Mexico.

Johnson, Frederick, and R.S. MacNeish
1972 Chronometric Dating in Chronology and Irrigation. In *Prehistory of the Tehuacán Valley*, F. Johnson, ed.. University of Texas Press, Austin.

Jones, Grant D., and R.R. Kautz
1981 *The Transition to Statehood in the New World.* Cambridge University Press.

Kaplan, Lawrence
1956 The Cultivated Bean of the Prehistoric Southwest. *Annals of the Missouri Botanical Gardens* 43:189-251.

Kauffman, Barbara, and David Batcho
1988 Final Report of Archaeological Investigations Along El Paso Electric Company's 345 KV Caliente-Newman-Amrad Transmission System on Fort Bliss, Texas. *Batcho & Kauffman Cultural Resources Report* 10, Las Cruces, New Mexico.

Kearny, Thomas H., and Robert H. Peebles
1951 *Arizona Flora.* University of California Press, Berkeley and Los Angeles.

Kelley, J.C.
1959 The Desert Cultures and the Balcones Phase. *American Antiquity* 24(3):276-88.

Kelly, V.C., and C. Silver
1952 Geology of the Caballos Mountains. *University of New Mexico Publications in Geology Series* 4. University of New Mexico Press, Albuquerque.

Kidder, Alfred Vincent
1932 The Artifacts of Pecos. *R.S. Peabody Foundation for Archaeology Publications.* Yale

1927 Southwestern Archaeological Conference. *Science,* 66.

Kidder, A.V., and S. Guernsey
1919 Archaeological Exploration in Northeastern Arizona. *BAE Bulletin* 65. Washington, D.C.

Kimball, John W.
1983 *Introduction to Immunology*. Macmillan, New York.

Lanning, Edward P.
1989 Archaeology of the Post Spring Site Jay-372–University of California. *Publication in American Archaeology and Ethnology* 3(3):237-336.

Lee, Henry C.
1984 *Identification and Grouping of Blood Stains.* Connecticut State Police, Forensic Science Laboratory, Meriden.

Lehmer, Donald J.
1949 Review of Cosgrove, C.B.: Caves of the Upper Gila and Hueco Areas in New Mexico and Texas. *American Antiquity* 114(3):236-37.

1948 The Jornada Branch of the Mogollon. *University of Arizona Social Science Bulletin* No. 17. University of Arizona Press, Tucson.

Leslie, Robert H.
1978 *Projectile Point Types and Sequences of the Eastern Jornada-Mogollon Extreme, New Mexico.* Transactions of the 13. Lames, Texas, and Hobbs, New Mexico.

Lindsay, Alexander J., Richard Ambler, Mary Anne Stein and Philip Hobler
1968 Survey and Excavations North and East of Navajo Mountain, Utah, 1959-1962. *Museum of N. Arizona Bulletin* 43, Glen Canyon Series 8, Flagstaff.

Lister, R.
1958 Archaeological Excavations in the Northern Sierra Madre Accidental, Chihuahua and Sonora, Mexico. *University of Colorado et al. Anthro. Series* No. 7. Boulder.

Lowenstein, Jerold M.
1985 Molecular Approaches to the Identification of Species. *American Scientist* 73:541-47.

Loy, Thomas H.
1983 Prehistoric Blood Residues: Detection on Tool Surfaces and Identification of Species of Origin. *Science* 220:1269-71.

MacCurdy, Nora
n.d. Petrographic Description of Pottery Types. Ms. on file, Gila Puebl Archives, Arizona State Museum. University of Arizona, Tucson.

MacMahon, James A.
1985 *Deserts*. Audubon Society Nature Guides Series. Knopf, New York.

MacNeish, Richard S.
1993 Preliminary Investigations of the Archaic in the Region of Las Cruces, New Mexico. *Historic and Natural Resources Report*. Andover Foundation for Archaeological Research, Andover, Massachusetts, and Directorate of Environment, U.S. Army, Fort Bliss, El Paso, Texas.

1992 *The Origin of Agriculture and Settled Life.* University of Oklahoma Press, Norman.

1989 Defining the Archaic Chihuahua Tradition. *Annual Report of the Andover Foundation for Archaeological Research*, Andover, Massachusetts.

1988 *The Beginnings of Agriculture in the American Southwest as seen from the Chihuahua Tradition.* Paper presented to the Society for American Archaeology, Phoenix.

1986 Preliminary Report on Archaeological Investigations at Tornillo Shelter, Southern Organ Mountains, New Mexico. *Andover Foundation for Archaeological Research Paper* No. 1. Andover, Massachusetts.

1981 The Transition to Statehood as Seen from the Mouth of a Cave, in *The Transition to Statehood in the New World.* Grant D. Jones and Robert Kautz, editors. Cambridge University Press.

1967 A Summary of the Subsistence in Environment and Subsistence. In *The Prehistory of the Tehuacán Valley*, D.S. Byers, ed. 1:290-309. University of Texas Press, Austin.

1978 *The Science of Archaeology?* Duxbury Press, North Scituate, Massachusetts.

1967 The Nonceramic Artifacts. In *The Prehistory of the Tehuacán Valley, Mexico,* Vol. 2, University of Texas Press, Austin.

1958 Preliminary Investigations in the Sierra de Tamaulipas, Mexico.

MacNeish, Richard S., Antoinette Nelken-Terner, and Angel Garcia Cook
1981 Introduction. In *Prehistory of the Ayacucho Basin, Peru.* University of Michigan Press, Ann Arbor.

MacNeish, Richard S., Robert K. Vierra, Antoinette Nelken-Terner, and Carl J. Phagan
1980 Nonceramic Artifacts. In *Prehistory of the Ayacucho Basin, Peru.* University of Michigan Press, Ann Arbor.

MacNeish, Richard S., and Angel Garcia Cook
1975 Excavation in the Rancho Diego Locality. In *The Prehistory of the Tehuacán Valley* 5, pp.69-73. University of Texas Press, Austin.

MacNeish, Richard S., Melvin L. Fowler, Angel Garcia Cook, Frederick A. Peterson, Antoinette Nelken-Terner and James A. Neely
1975 Excavations and Reconnaissance. In *The Prehistory of the Tehuacán Valley* 5. University of Texas Press, Austin.

MacNeish, Richard S., and C. Irwin
1962 Preceramic Projectile Point Typology in Mexico. Papers on file, Congress of Americaniste, Mexico City.

Mangelsdorf, Paul C.
1974 *Corn: Its Origin, Evolution and Improvement.* Harvard University Press, Cambridge, Massachusetts.

Mangelsdorf, Paul C., R. S. MacNeish, and Walton C. Galinat
1967 Prehistoric Maize, Teosinte and Tripsicum from Tamaulipas, Mexico. *Botanical Museum Leaflets* 22:33-63. Harvard University, Cambridge, Massachusetts.

Mangelsdorf, Paul C., and R.H. Lister
1956 Archaeological Evidence on the Evolution of Maize in Northwestern Mexico. *Botanical Museum Leaflets* 17:151-177, Harvard University, Cambridge, Massachusetts.

Marino, Bruno D., Michael B. McElroy, Steven C. Wofsy and Michael J. DeNiro
1990 *Hydrogen and Oxygen Ratios of Terrestrial Plant Cellulose: Can They Be Used to Reconstruct Regional Hydrologic Cycles?* Papers presented at the Chapman Conference, June, 1990. Cambridge, Massachusetts.

Martin, Paul S.
1963 *The Last 10,000 Years: A Fossil Pollen Record of the American Southwest.* University of Arizona Press, Tucson.

Martin, Paul S., and Fred Plog
1973 *The Archaeology of Arizona*. Natural History Press. Doubleday, New York.

Martin, Paul S., J. B. Rinaldo, Elaine Bluhm, Hugh C. Cutler, and Roger George
1952 Mogollon Cultural Continuity and Change: The Stratigraphic Analysis of Tularosa and Cordova Caves. *Fieldiana: Anthropology* 40, Chicago Natural History Museum, Chicago.

Mayer-Oakes, William, and R.S. MacNeish
1964 *Archaeological Research Design*. A critiqued paper presented at the 63rd Annual Meeting of the American Anthropological Association.

McGregor, John C.
1965 *Southwestern Archaeology*, 2nd ed. University of Illinois Press, Urbana.

Mera, H.P.
1943 An Outline of Ceramic Developments in Southern and Southeastern New Mexico. *Laboratory of Anthropology Technical Series Bulletin* 11. Santa Fe.

Michels, J., I. Tsong, and G. Smith
1983 Experimentally Derived Hydration Rates in Obsidian Dating. *Archaeometry* 25:107.

Mills, Barbara
1984 Functional Analysis of Ceramics from the Anderson site. In Ladder Ranch Research Project, Margaret C. Nelson, ed., 67-82. *Technical Series of the Maxwell Museum of Anthropology* No. 1. Albuquerque, New Mexico.

Miller, Miles R.
1989 Archaeological Excavations at the Gobernadora and Ojasen Sites: Doña Ana Phase Settlement in the Western Hueco Basin, El Paso County, Texas. *New Mexico State University, Center for Archaeological Research Report* 673, Las Cruces.

Minnis, Paul E.
1985 Domesticating People and Plants in the Greater Southwest. In Prehistoric Food Production in North America, R.I. Ford, ed. *Papers of Museum of Anthropology* No. 75, University of Michigan, Ann Arbor.

Mohr and Sample
1959 San Jose Sites in Southeastern Utah. *El Palacio*, Vol. 66, No. 4. Santa Fe, New Mexico.

Morenon, E.P., and T.R. Hays
1984 *Archaeological Investigations in the Placitas Arroyo, New Mexico.* Archaeology Program, Institute of Applied Sciences, North Texas State University, Denton.

Morris, Earl H. and R.F. Burgh
1954 Basket-Maker II Sites Near Durango, Colorado. *Carnegie Institution of Washington, Publication* 604, Washington, D.C.

O'Laughlin, Thomas C.
1985 Early Formative Ceramic Assemblages in the Mesilla Valley of Southern New Mexico. In Views of the Jornada Mogollon, Colleen M. Beck, ed. *Eastern New Mexico University Contributions to Anthropology* Vol. 12. Portales.

1980 The Keystone Dam Site. *Publications in Anthropology*, No. 8. El Paso Centennial Museum, University of Texas at El Paso.

1968 La Cueva. *The Artifact* 3(2):3-11. El Paso Archaeological Society.

Parry, William J., and A.L. Christensen
1987 Prehistoric Stone Technology on Northern Black Mesa, Arizona. *Center for Archaeological Investigations* No. 2. Carbondale, Illinois.

Perrins, C., and L.A. Middleton
1985 *The Encyclopedia of Birds.* Facts on File, New York.

Plog, Fred T.
1974 *The Study of Prehistoric Change.* Academic Press, New York.

Plog, Fred T., and J.N. Hill
1971 Explaining Variability in the Distribution of Site. In *The Distribution of Prehistoric Population Aggregates*, G.J. Gummerman, ed. Prescott College Press.

Pope, Clifford
1960 *The Reptile World.* Knopf, New York.

Powell, Shirley
1985 Current Research, Greater Southwest. *American Antiquity* 50(4):912-14.

Redman, Charles L.
1978 *The Rise of Civilizaion.* Freamn, San Francisco.

Reily, Anita M.
1974 Petrographic Studies of Mimbres Sherds. *Pottery Southwest* 1(3)9-11.

Renaud, E.B.
1942 Reconnaissance in the Upper Rio Grande Valley, Colorado, and Northern New Mexico. *University of Denver Publication in Anthropology.* Denver.

Rinaldo, J.P., and E.A. Bluhm
1956 Late Mogollon Pottery Types of the Reserve Area. *Fieldiana: Anthropology* 36(7). Chicago Natural History Museum, Chicago.

Roberts, F.H.H.
1935 A Folsom Complex. *Smithsonian Miscellaneous Collections* Vol. 94, No. 4. Washington, D.C.

Rogers, Malcom J.
1939 Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Desert Areas. *San Diego Museum Papers* No. 3. San Diego, California.

Rugge, Dale
1976 A petrographic study of ceramics from the Mimbres River Valley. Ms. on file, Maxwell Museum of Anthropology, University of New Mexico, Albuquerque.
1977 Petrographic Analysis. Ms. on file, Maxwell Museum of Anthropology, University of New Mexico, Albuquerque.

1985 Petrographic Analysis of Ceramic Technology. In *Archaeological testing at the Fairchild Site (LA45732) Otero County, New Mexico*. Office of Contract Archaeology, University of New Mexico, Albuquerque.

1986 Petrographic Analysis of Mimbres Series Ceramics from the Fort Bliss Military Reservation, Texas and New Mexico. Ms. on file, Directorate of Environment, Fort Bliss, Texas.

1988 Petrographic Studies. In *The Border Star 85 Survey*, Timothy J. Seaman, William H. Doleman and Richard C. Chapman, eds., pp. 185-89. Office of Contract Archaeology, University of New Mexico, Albuquerque.

Sanchez, Arturo Guevara

1989 *Algunos Sitios Arqueológicos de Grupos en Pproceso de Transculturación del Centro del Estado de Chihuahua*. Instituto Nacional de Antropología e Historia, Mexico, D.F.

Satterwhite, Melvin B., and Judy Ehlen

1980 *Vegetation and Terrain Relationships in South-central New Mexico and Western Texas*. United States Army Corps of Engineers, Engineer Topographic Laboratories, Fort Belvoir, Virginia.

Sayles, E.B., et al.

1983 The Cochise Cultural Sequence in Southeastern Arizona, *Anthropological papers of the University of Oregon* No. 42. University of Arizona Press, Tucson.

Schaafsma, Curtis

1974 The Hatch Site: Archaeological Salvage Excavations on Interstate 25, Doña Ana County, New Mexico. *Laboratory of Anthropology Note* 96. Museum of New Mexico, Santa Fe.

Schaafsma, Polly

1980 The Rock Art of Utah. *Papers of the Peabody Museum of Archaeology and Ethnology* Vol. 63. Harvard University, Cambridge.

Schiffer, M.D.

1982 Hohokam Chronology: An Essay on History and Method. In *Hohokam and Patayan* 294-344, R.H. McGuire and M.B. Schiffer, eds. Academic Press, New York.

Schoeninger, Margaret J., Michael J. DeNiro, and Henrik Tauber.

1983 Stable Nitrogen Isotopic Ratios of Bone Collegen Reflect Marine and Terrestrial Components of Prehistoric Human Diet. *Science* 220:1381-83.

Seager, William R.

1981 Geology of the Organ Mountains and Southern San Andres Mountains, New Mexico. *New Mexico Bureau of Mines and Mineral Resources Memoir* 36. Socorro.

Seager, William R., and John W. Hawley

1973 Geology of the Rincon Quadrangle, New Mexico. *New Mexico Bureau of Mines and Mineral Resources Bulletin* 101. Socorro.

Seaman, Timothy J., and Barbara Mills

1985 *What Are We Measuring? Rim Thickness Indices and Their Implications for Changes in Vessel Use*. Paper presented at the Fourth Jornada Conference, Tularosa, New Mexico.

Shafer, Harry J.
1986 *Ancient Texans.* Texas Monthly Press, Austin.

Shafer, Harry K., and Richard G. Holloway
1979 Organic Residue Analysis in Determining Stone Tool Function. In *Lithic Use-wear Analysis:*385-99, Brian Hayden, ed. Academic Press, New York.

Sheridan, David
1981 *Desertification of the United States.* Council on Environmental Quality, Washington, D.C.

Simmons, A.H.
1986 New Evidence for the Early Use of Cultigens in the American Southwest. *American Antiquity* 51:73-88.

Stevenson, Christopher M.
1986 Status Report on the Hydration Rate Development Study for the Rio Grande Group II Obsidian. Ms. on file, Obsidian Hydration Dating Laboratory. New Mexico State University, Las Cruces.

Stewart, Frances L., and Peter W. Stahl
1977 Cautionary Note on Edible Meat Poundage Figures. *American Antiquity* 42(2):267-69.

Suhm, Dee Ann, and Alex D. Krieger
1954 *An Introductory Handbook of Texas Archaeology.* The Texas Archaeological Society, Abilene.

Sudar-Laumbach, Toni
1982 Observations on Mimbres Whiteware. In *Mogollon Archaeology: Proceedings of the 1980 Mogollon Conference,* Patrick H. Beckett, ed., pp. 137-46. Acoma Books.

Taylor, Walter W.
1966 Archaic Culture Adjacent to the Northeastern Frontiers of Mesoamerica. *Middle American Handbook.* Smithsonian Institute, Washington, D.C.

1954 Southwestern Archaeology: Its History and Theory. *American Anthropologist* 56(4, pt.1):561-75.

Thompson, Raymond H.
1983 Introduction. In *The Cochise Cultural Sequence in Southeastern Arizona,* edited by E.B. Sayles, et al., 1-5. University of Arizona Press, Tucson.

Thoms, Alson Vern
1977 *A Preliminary Projectile Point Typology for the Southern Portion of the Northern Rio Grande Region, New Mexico.* MA thesis, Texas Tech University, Lubbock.

Tice, Ben
1986 *A Description of Plainware Rim Sherds from the Old Socorro Mission Site.* Unpublished MA thesis. Social Science Department, University of Texas at El Paso.

Turner, Sue E., and Thomas R. Hester
1985 *A Field Guide to Stone Artifacts of Texas Indians.* Texas Monthly Press, Austin.

Underhill, Ruth
1944 *Pueblo Crafts.* A publication of the Education Division, U.S. Indian Service, Department of the Interior. Phoenix Indian School. Phoenix.

Upham, Steadman
1975 National Science Grant Proposal. Ms. on file, Department of Sociology and Anthropology, New Mexico State University, Las Cruces.

Upham, Steadman, Richard S. MacNeish, Walton C. Galinat and Christopher M. Stevenson
1987 Evidence Concerning the Origin of Maiz de Ocho. *American Anthropologist,* 89(2), June.

Upham, Steadman, Christopher M. Stevenson, R.E. Newton, and M. Johnson
1986 Chronometric Dating of San Pedro Style Projectile Points in Southern New Mexico. In Mogollon Variability, C. Benson and S. Upham, eds., *Occasional Papers of the University Museum* 15, pp. 88-96. New Mexico State University, Las Cruces.

Van Devender, Thomas R., and W.G. Spaulding
1979 Development of Vegetation and Climate in the Southwestern United States. *Science* 204:701-10.

Vierra, Robert
1980 Introduction. In *Prehistory of the Ayacucho Basin, Peru.* University of Michigan Press, Ann Arbor.

Wallace, H.A., and W.L. Brown
1956 *Corn and Its Early Fathers.* Michigan State University Press and Lakeside Press. Chicago.

Warnock, Barton H.
1974 *Wildflowers of the Guadalupe Mountains and the Sand Dune Country, Texas.* Sul Ross State University, Alpine, Texas.

Warren, C.W.
1967 The San Dieguito Complex: A Review and Hypothesis. *American Antiquity* 32(2).

Waters, Michael R.
1986 The Geoarchaeology of Whitewater Draw, Arizona. *Anthropological Papers of the University of Arizona* No. 4. University of Arizona Press, Tucson.

Whalen, Michael E.
1977 Settlement Patterns of the Eastern Hueco Bolson. *Publications in Anthropology* No. 4. El Paso Centennial Museum, University of Texas at El Paso.

Wheat, Joe Ben
1955 Mogollon Culture Prior to A.D. 1000. *Memoirs of the Society for American Archaeology,* No. 10.

White, Thomas
1953 A Method of Calculating the Dietary Percentage of Various Food Animals Utilized by Aboriginal Peoples. *American Antiquity* 4:396-98. Taylor, Walter W.

Wendorf, Fred and John P. Miller
1959 Artifacts From High Mountain Sites in the Sangre De Cristo Range, New Mexico. *El Palacio* 66(2):37-52.

Wendorf, Fred and Tully Thomas
1951 Early Man Sites Near Concho, Arizona. *American Antiquity* 17(2):107-14.

West, Ken
1982 *A Study of El Paso Brown Rim Form.* Unpublished MA thesis, Department of Social Sciences, University of Texas at El Paso.

Whalen, Michael E.
1978 Settlement Patterns of the Western Hueco Basin. *El Paso Centennial Museum Anthropological Paper* No. 6, University of Texas at El Paso.

1980 *Special Studies in the Archaeology of the Hueco Basin.* El Paso Centennial Museum and University of Texas at El Paso.

Wheat, Joe Ben
1955 Mogollon Culture Prior to A.D. 1000. *American Anthropological Association Memoir* 82. Menasha, Wisconsin.

Willey, Gordon R.
1966 *An Introduction to American Archaeology,* Vol. 1, Prentice-Hall, Englewood Cliffs, New Jersey.

Willey, Gordon R., and J. Sabloff
1980 *A History of American Archaeology,* 2nd ed. W.H. Freeman, San Francisco, California.

Willey, Gordon, and P. Phillips
1958 *Method and Theory in American Archaeology.* University of Chicago Press.

Williams, Charlotte C., and Jean S. Martin
1980 A Lithic Collection from La Cueva. Paper on file, Lithic Technology Section of the University of Texas at El Paso.

Wills, W.H.
1988 Early Prehistoric Agriculture in the American Southwest. School of American Research, Santa Fe.

Wilmsen, Edwin
1973 Functional Analysis of Flake Stone Tools. *American Antiquity* 30(2):131-33.

Wimberly, Mark L., and Peter Eidenbach
1981 Preliminary Analysis of Faunal Remains from Fresnal Shelter, New Mexico. In Archaeological Essays in Honor of Mark Wimberly, Michael S. Foster, ed. *The Artifact* 19(3&4):21-40. El Paso Archaeological Society.

1972 A Preliminary Analysis of Faunal Material from Fresnal Shelter, New Mexico. *Training Manual.* Human Systems Research, Tularosa, New Mexico.

1972 Fresnal Cave, ms..

Woodbury, Richard
1979 Prehistory: Introduction. In *Handbook of North American Indians, Southwest,* Alfonso Ortiz, ed., 9:23-32. Smithsonian Institution, Washington, D.C.

Woodbury, Richard, and E. Zubrow
1979 Agricultural Beginnings, 2000 B.C.-A.D. 500. In *Handbook of North American Indians, Southwest,* Alfonso Ortiz, ed., 9:43-108. Smithsonian Institution, Washington, D.C.

York, J.C., and W.A. Dick-Peddie
1969 Vegetation Changes in Southern New Mexico During the Past Hundred Years. In *Arid Lands in Perspective,* W.B. McGinnies and J.B. Goldman, eds., 155-66. University of Arizona Press, Tucson.

Zubrow, Ezra B.W.
1972 Carrying Capacity and Dynamic Equilibrium of the Prehistoric Southwest. In *Contemporary Archaeology,* Mark Leone, ed., 268-79. Southern Illinois University Press, Carbondale.